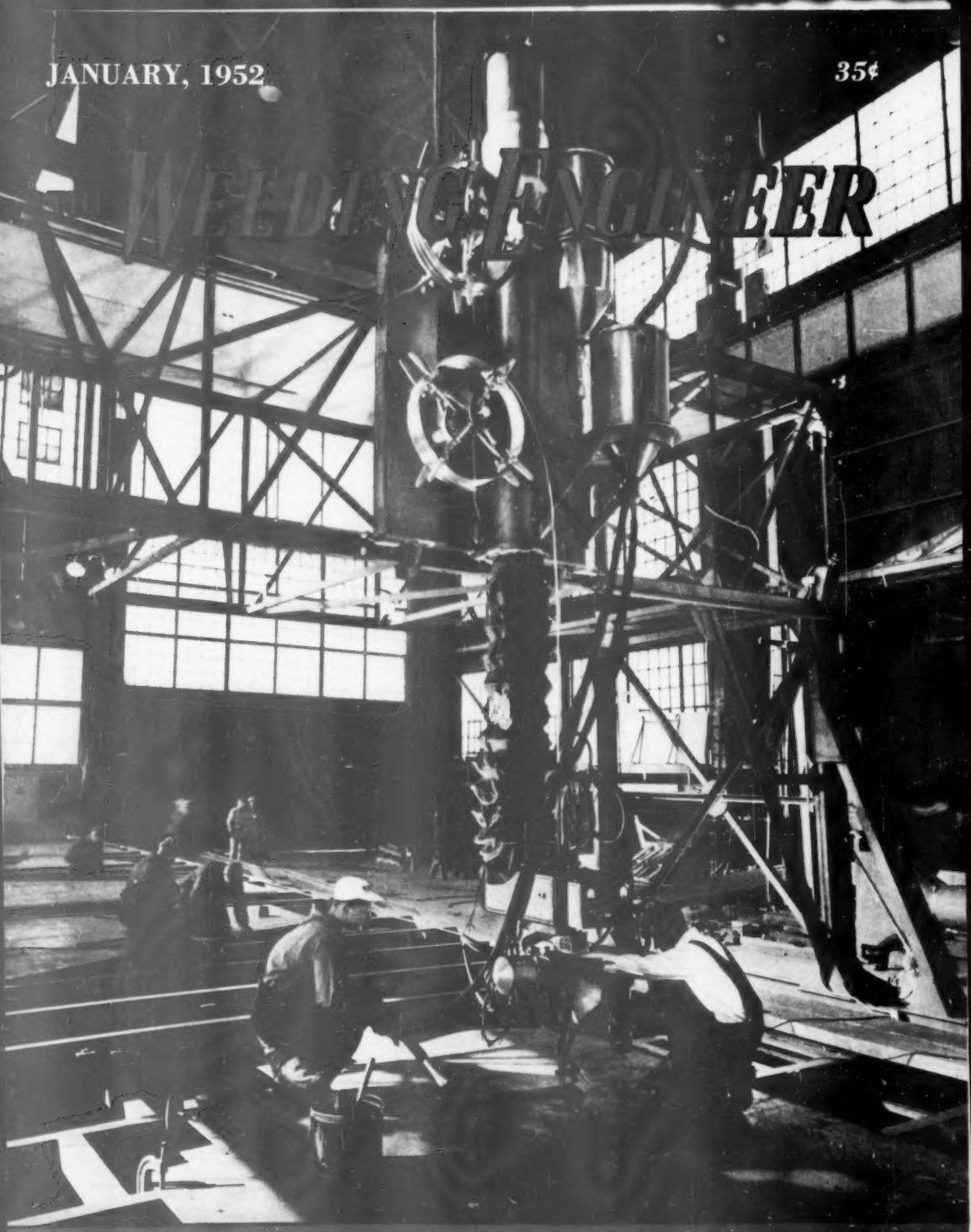
JANUARY, 1952 35¢

WELDING ENGINEER



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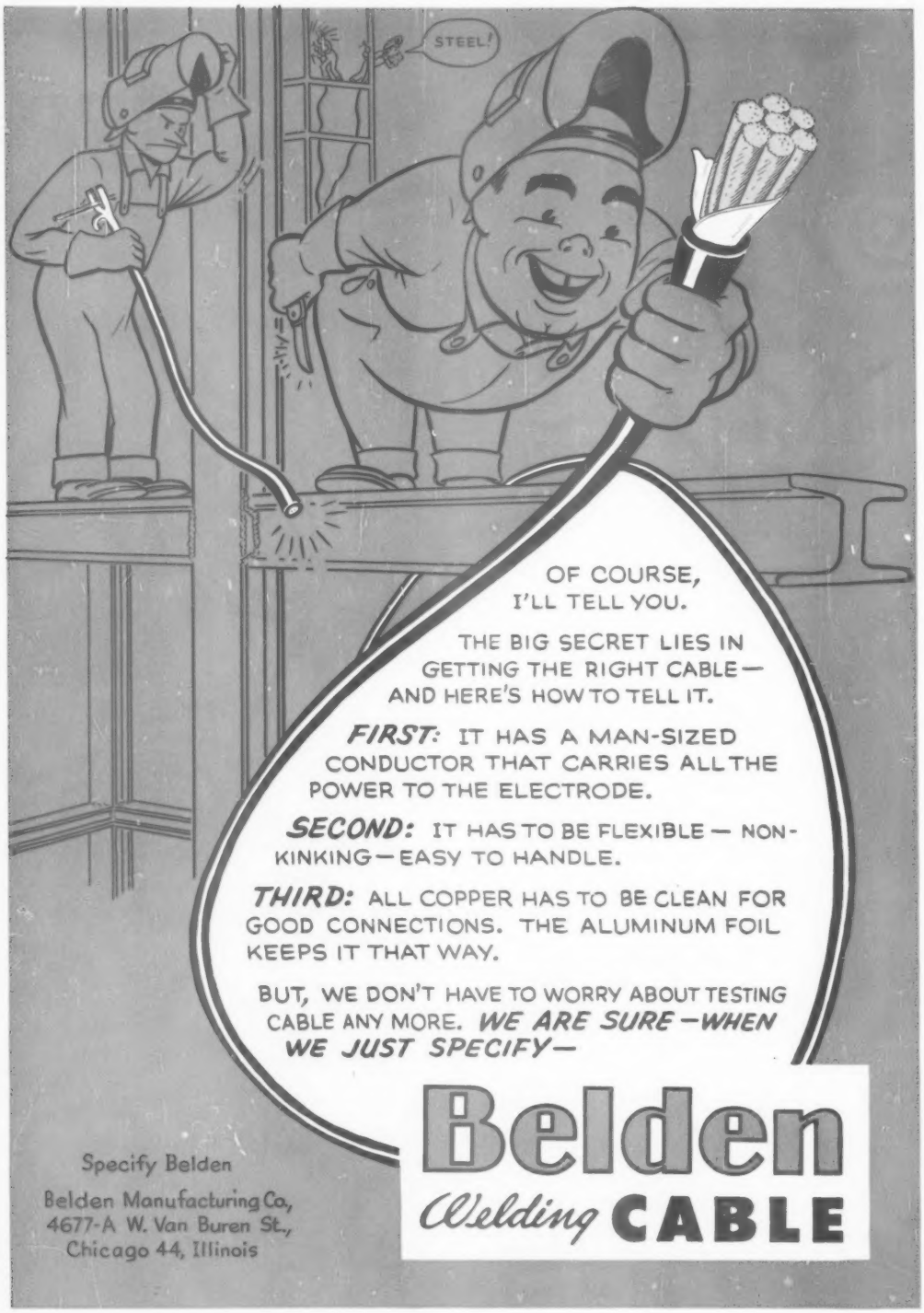
STEEL!
OF COURSE, I'LL TELL YOU.
THE BIG SECRET LIES IN GETTING THE RIGHT CABLE— AND HERE'S HOW TO TELL IT.
FIRST: IT HAS A MAN-SIZED CONDUCTOR THAT CARRIES ALL THE POWER TO THE ELECTRODE.
SECOND: IT HAS TO BE FLEXIBLE — NON-KINKING — EASY TO HANDLE.
THIRD: ALL COPPER HAS TO BE CLEAN FOR GOOD CONNECTIONS. THE ALUMINUM FOIL KEEPS IT THAT WAY.
BUT, WE DON'T HAVE TO WORRY ABOUT TESTING CABLE ANY MORE. WE ARE SURE — WHEN WE JUST SPECIFY —
Belden
Welding CABLE
Specify Belden
Belden Manufacturing Co,
4677-A W. Van Buren St.,
Chicago 44, Illinois

Counterbalanced engine

Rugged, economical oversized industrial engine. Snappy—smooth running. Gives wonderful welding performance . . . all weather.

Extra capacity generator

Guarantees long hours of continuous heavy duty welding. Oversize 4 pole exciter means quick arc recovery and instant arc.

1 KW 110 volt auxiliary power

Supplies power for operating lights, tools, etc., where normal power is not available.

Automatic idling device

Saves fuel, $$$, and reduces wear by slowing down engine speed when arc is not being used.

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25 gal. capacity. Lets you weld for days without refilling. Saves plenty on every job.

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Gives operator choice of 1,000 combinations of welding heat.

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Reactance automatically adjusts to meet requirements of each welding range. Assures better, faster welds under all conditions.

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Instant and positive. Makes it fast and simple to change electrodes and polarity.

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. . . in the entire welding range—very important. Operator has choice of 1,000 volt-ampere combinations.

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Without obligation, send latest catalog and full information on items checked.

- ☐ Gas Drive Welders
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- ☐ Hobart Accessories

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FIRM_____

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CESCO RIGHT... before your Eyes!

• When welders must wear **Hard Hats** give them CESCO Dual Protectors. Spring Clip connectors permit instant detachment of helmet from Fiberglas Caps. Heads are protected even when helmets are not in use. Goggles mounted on cap by swivel mechanism may be quickly raised or lowered. They're *right* for safety —*right* for comfort—the *right* protection for your welders.

Send TODAY *for CESCO literature and the name of your CESCO safety equipment distributor*

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THE WELDING ENGINEER

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JANUARY, 1952

COVER: Welding the 12-ton rudder of the "John G. Munson," newly launched 666-ft limestone carrier for U. S. Steel's Bradley Transportation Co. (see page 70). Photo courtesy Linde Air Products Co.

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new Unigoggle

Another JACKSON First!

A One-Cup Headrest Goggle made expressly for Gas Welding, Flame Cutting and Brazing

- **GOGGLE,** with its large ventilated inside area, is lighter, cooler, easier to wear. Its one-piece molded plastic is strong, flame resistant, non irritating to the skin. It bears lightly, yet firmly, against cheeks and forehead, where its good fit excludes light and heat rays. It may be worn over regular prescription glasses or safety spectacles.
- **LENS,** available in Federal Specification shades 3 through 6, is of standard 2 by 4¼" size, protected by a cover glass. New spring clip fastening makes the lens easy to replace; no tools are needed.
- **HEADREST,** with cork sweatband for comfort, is of light, easy to clean plastic, and is readily adjusted to any head size. Spring, concealed within telescopic arms, holds goggle snugly against the face. Hinged from opposite sides, weight is evenly distributed.

JACKSON UNIGOGGLE type W-60, shown above, has plastic headrest, telescopic arms.

JACKSON UNIGOGGLE type WR-60, shown at left, has same eyecup and choice of lens shades, but is held against the face by an adjustable, elastic headband.

Goggle fits cheeks and forehead snugly, gently, with wide rim for comfort

To raise, pull up and forward in one quick movement . . . takes one second

Put back on guard again, goggle protects this welder quickly, comfortably

JACKSON PRODUCTS
WARREN · MICHIGAN

sold World-Wide . . . through Distributors and Dealers

NEWS FROM WASHINGTON

Scrap Shortage More Critical Than Ever

YOU'VE been hearing of the growing steel scrap shortage for some time now. However, since more steel is being produced than ever before, unless you are directly involved, you may find it hard to understand the shortage reports. But here's something you can understand. The men who are responsible for the mobilization program, Defense Mobilizer Wilson and Defense Administrator Fleischmann, think it is so critical that they invited the editors and publishers of about 2,800 business and trade papers to come to Washington to discuss the importance to businessmen in every manufacturing and industrial field of solving the iron, steel and non-ferrous scrap shortages.

One recent order, M-92, covers wrecked cars in junkyards and is an inventory control order designed to drive about two million tons of iron and steel scrap in the next three months from the nation's auto wrecking yards. It will force auto graveyard operators to dispose of their pre-1946 autos and other wrecked cars in order to continue to operate.

Renegotiation Rules Clarify Exemptions

IF YOU are a manufacturer or a distributor involved with a defense contract or subcontract, now is a good time to start preparing for future renegotiation.

In general, all defense contracts or subcontracts are subject to renegotiation provided they total more than $250,000 per year. However, there are some exceptions, such as supplying raw materials and agricultural products. In a recent regulation, distributors may be exempted under some circumstances. Two regulations were issued recently by the Renegotiation Board to simplify the procedure of profits recapture on government contracts. The first one exempted certain stock items from renegotiation while the second clarified some of the provisions of the Renegotiation Act of 1951.

For more complete details, write to the Renegotiation Board, 726 General Services Bldg. Washington 25, D. C.

Business Offered Aid in Placing ACM Orders

THOSE who have tried, without success, to place authorized controlled materials orders with producers of steel, copper or aluminum can now get assistance from NPA Metals and Minerals Bureau in doing so. The Bureau will act as an expediting agent to see that allotments under the Controlled Materials Plan find a place as firm orders on producers' mill schedules.

Persons who need spot assistance need not, under the new set-up, go to Washington to get it. Instead, they can make application for assistance on NPA form 148, which, when properly filled out, is forwarded to the appropriate section: Aluminum, Copper Brass Mill Products, Copper Wire Mill Products, Copper and Copper Base Alloy Foundry Products, or Steel Products.

In offering such help, NPA emphasized that it was to be made available only to those who had first made every effort to place the orders themselves.

Copies of Form 148 are available at Department of Commerce field offices, at NPA's Office of Small Business and in various NPA industry and metals divisions.

Publications Available to Aid Businessmen

A NUMBER of government publications, recently issued, contain valuable information to help the businessman. Included are the following:

"A Renegotiation Guide": A guide on renegotiation of defense contracts, telling what income from defense contracts is subject to renegotiation and what is not. Available without charge from: Renegotiation Board, 726 General Services Bldg., Washington 25, D. C.

"Handbook of Emergency Defense Activities": A 125-page booklet listing names, addresses and telephone numbers of all Federal agencies which function wholly or partly in the national defense program. Available for 30c from: Government Printing Office, Washington 25, D. C.

"List of Basic Materials and Alternates": The third edition has now been published by the Defense Production Authority. Lists the materials in various degrees of short supply, and suggests alternates to be substituted. Up to five copies available without charge from district and regional offices of the Department of Commerce.

"Manual on Preservation, Packaging and Packing Military Supplies": A guide for use by industrial firms. Available for $1.75 from Superintendent of Documents, Government Printing Office, Washington 25, D.C. Give the full name of the manual and the designation "NAVEXOS P-938" when ordering.

Greater Leeway for Gas and Oil Industry

IN A REVISION of M-46, effective Dec. 12, the National Production Authority has (1) given oil and gas operators more leeway in getting small amounts of controlled materials for maintenance repair and operating supplies, production and small construction operations; and (2) established a procedure for the purchase of line pipe for such purposes. At the same time, NPA revoked M-46 Supplement 1.

Construction Price Increases Authorized

ADJUSTMENTS in construction industry prices to reflect increased material and labor costs have been authorized by OPS. The new ceilings for a variety of builders are based on current costs, plus 90% of preKorean margins.

OPS estimates that labor costs have gone up about 10% since the Korean outbreak, and that material

costs have risen about 12%. This, coupled with the 90% profit margin figure, should give contractors about the same dollars-and-cents profit margins as before the war, OPS officials believe.

Patent Office Offers Free Inventions List

IF YOU are looking for new directions in which to expand your business, a good place to start is a new publication offered by the Government Patents Board. It has compiled a list, "Government-Owned Inventions for Free Use," consisting of 2,339 patents owned by the government and available to businessmen for use without charge. The publication is available for $1 from Commerce Department field offices, or from the Government Printing Office, Washington 25, D. C.

OPS Steel Rollback Aimed at Grey Market

A PRICE order on warehouse steel and all other steel not covered by CMP has been issued by OPS, in an effort to wipe out the substantial grey market on this item. The new order rolls back most warehouse steel prices by $1 to $3 a ton below the freeze prices of January 1951.

Under the order, warehouse ceilings are based on current mill prices, plus the percentage mark-ups used by the industry before the start of the Korean war. To this, the warehousemen will add their transportation costs plus the usual extras charged by the mills. The percentage mark-ups are specified for the basic iron and steel products in different sections of the United States. Prices are to be refigured each month, on the basis of the average mill price paid on all invoices during the previous month. Consumers who resell the steel they buy will be permitted to charge no more than $2 a ton over the mill price. Anyone who buys such excess stock for resale can add 20% to the price at which he purchased.

By thus relating all resales to the original mill price, OPS hopes to eliminate the "daisy chain" practice, whereby brokers pass products along from one to another, each adding a high percentage mark-up, until the price is jacked up several hundred percent between the mill and the fabricator.

Freight Program up, but No More Material

DESPITE a program which calls for the production of 24,200 freight cars for the first quarter of 1952, the National Production Authority set up its material allocations on the basis of its original quota of only 21,200 cars. Shortages in steel, copper and aluminum, according to NPA, are the reason for the material deficit.

Program determinations on freight car building, according to a spokesman for NPA's Railroad Equipment Division, were based on the government's recognition of the importance of a sound and healthy railroad system. It is believed that car builders will be able to meet the new, high quota by using materials from inventories and by conservation and substitution.

Of the 24,200 car total, 2,500 are tank cars, 20,500 domestic freight cars, and 1,200 export cars. This falls below the fourth quarter 1951 program of 27,502 cars.

Price Hikes by Small Business Simplified

A NEW and simpler formula for small manufacturers and sellers of industrial services to enable them to get the increased prices for their products under the Capehart amendment has been announced by the Office of Price Stabilization. This new formula was announced in General Overriding Regulation 20, effective November 28.

All manufacturers are eligible if their net sales did not exceed $250,000 in their latest fiscal year ending no later than July 31, 1951. Manufacturers who buy and resell products of other manufacturers are also eligible, as are sellers of industrial services like blacksmiths and weldors.

Businessmen who want to take the cost adjustment increases that are allowed under GOR 20 must fill out Public Form 106 and file it with the nearest OPS district office. If no word is received from OPS within 30 days, they are free to put the new ceilings into effect.

CMP Overhaul Hikes Small Users' Quotas

A STREAMLINING of the NPA's much amended CMP Regulation 1 has resulted in an important advantage for "small" users of controlled materials. Beginning with orders to be filled in the second quarter of 1952, those who use no more than 30 tons of carbon steel, 8 tons of alloy steel, 1,500 pounds of stainless steel, 3,000 pounds of copper and copper-base alloy, and 2,000 pounds of aluminum a quarter, can certify their own orders for delivery, without filing for allotments from NPA. This represents a substantial increase over the present limits for self-certification.

After the first of the year, orders placed for delivery in the previous quarter and not received within the quarter may be accepted up to fifteen days after the deadline, instead of only seven, as was the previous rule.

Restrictions on MRO Supplies for Export

FIVE items have been removed from coverage under NPA's Order M-79, which provides assistance in the procurement of maintenance, repair and operating supplies for export. The dollar value of another item has been limited.

Replacement parts for machine tools, parts and accessories for motor vehicles, specialized industrial gloves, leather industrial belting and abrasives were the items removed from the list. Coverage of laboratory supplies, instruments and equipment under the order has been limited to items of unit value no greater than $750.

man has no more faithful servant than this perfect flame . . . .

The versatile flame of a good welding or cutting torch in the hands of an experienced operator can create untold values in the services of man.

This really fine welding torch combines safety for your operator with economy for your pocketbook . . . and these are two reasons why the National torch is so well liked by the experts.

So, when you buy a torch or an entire welding or flame cutting outfit, seek one which will serve you best and with the least possible annoyances. Do get an outfit capable to work for you for years . . . one with the unquestioned ability to stay on the job rather than to rest in the repair shop.

Buy the very best . . .
it costs the very least.

Made by National SINCE 1910 **WELDING EQUIPMENT CO.,** San Francisco 5, California

815

Give your welder a chance to be proud of his footage!

It's *waste welding time* when welders have to climb over, prop up or flop the work piece to get at the different seams.

It's *all arc-time* when Worthington-Ransome Turning Rolls and Welding Positioners are used. All welds can be tilted or turned into position—without delay—for continuous downhand welding.

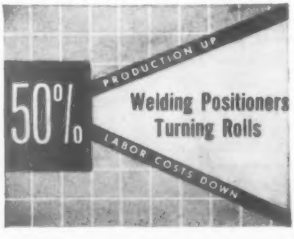
Result—up to 50% more footage, *better* welds (using higher current and heavier rods), less welding rod waste.

Write Worthington Pump and Machinery Corporation, Dunellen, New Jersey, for bulletins or additional information.

With one set-up, work piece may be tilted and rotated for either automatic or manual welding. Welding Positioner capacities from 100 lb to 30 tons.

Production goes up on manual or automatic welding, whether repetitive or job work. Turning Rolls from 3 to 150 tons, stationary or self-propelled.

WORTHINGTON



WATCH FOR THIS MARQUETTE FULL PAGE!

IN THE JAN. 26th ISSUE SATURDAY EVENING POST

No job too big ...or too little!

Year by year, welding has come to play a greater and greater part in both the output and the maintenance of the huge and busy plant that is America. The skills of the welder are being applied every minute of the day to every kind of metal joining problem—from the smallest repair job—to the biggest metal fabricating job.

Behind the magic of fusing metals is the know-how of a trained specialist combined with the most modern precision-engineered equipment. Marquette welding equipment is known everywhere for its design and engineering, and for its outstanding performance under the most exacting conditions. To be Marquette equipped is to be well-equipped!

INDUSTRY—Industry produces by welding—keeps in repair by welding. Good welds depend on the right equipment, the right electrode for the job.

TRANSPORTATION—Marquette equipment and welding electrodes help keep America's transportation moving.

AGRICULTURE—Farmers depend on welding to keep machines running—to put them back to work when breakdowns happen.

FREE. If your business is welding, write for helpful 64 page, "Guide to Better Welding."

MARQUETTE
Welding & Automotive Service Equipment

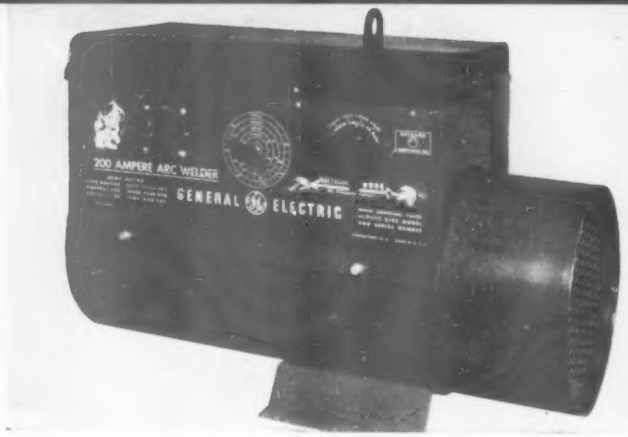
WELDING ELECTRODES AND RODS · ARC AND OXY ACETYLENE WELDING EQUIPMENT · BATTERY CHARGERS · TOW CRANES

Marquette Manufacturing Company · 307 East Hennepin Avenue · Minneapolis 14, Minnesota

MARQUETTE MANUFACTURING COMPANY • 307 EAST HENNEPIN • MINNEAPOLIS 14, MINNESOTA

New

New WD-4200 and smaller WD-4150 are compact, portable welders with wide current range and versatility of operation. 30 volts, 50% duty cycle—220/440 volts; 60 cycles; 150 and 200 amps.



D-C WELDER

Features Versatility and Ease of Operation, High Production, Low Costs

VERSATILE

The new G-E WD-4200 can be used with:

- a variety of electrodes from $\frac{1}{16}$ to $\frac{3}{8}$ inches, and as large as $\frac{1}{4}$ in. for special short jobs
- wide current range—from 30 to 250 amps, or as low as 15 amps with a special, easily-installed resistor
- both Inert-Arc and metal-arc welding

EASY TO OPERATE

Operators like the new manual starter, simple dial controls and a stable arc which can be maintained at any current setting. The compact, lightweight WD-4200 is easily portable, too.

INCREASES PRODUCTION

High instantaneous voltage makes the arc strike every time on heavy or light-gage stock, reducing spoilage.

The WD-4200 is suited to both fast metal-arc welding and Inert-Arc welding of copper, stainless steel and alloy steels, including sheet metal from $\frac{1}{32}$ to $\frac{3}{16}$ inches.

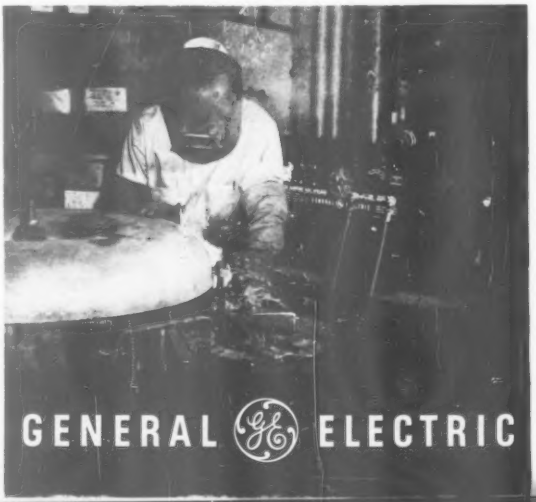
LOWERS COSTS

Reduces Power Costs 10 to 15%

The WD-4200 substantially lowers costs because the full range of current is obtained without the use of a current-limiting resistor.

Limited current peaks conserve electrodes and help prevent spatter and burn-through. You save on original cost, production *and* upkeep expense!

It's easy to select *just the right* current (above photo.) The operator can use a wide variety of electrodes for either Inert-Arc or metal-arc welding.



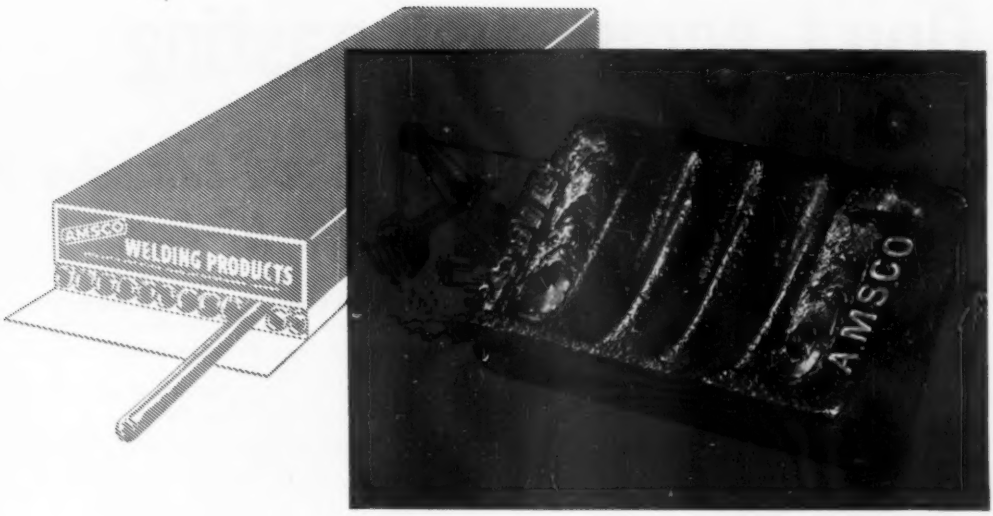
Section E 711-19
General Electric Company
Schenectady 5, N. Y.

Please send me your bulletin, GEC-847, which describes the newest G-E WD4200 Generator Welder.

Bulletin needed for:

.....Reference purposes
.....Planning immediate project

Name.....
(Please print)
Position.....
Address.....
City.....Zone.....State.....



NOW! Wear your point and have it too!

This new catalog can help you save money on repair costs . . .

It's packed with information on the new "Wear-Sharp"—and the entire AMSCO Weldment line. Complete with installation instructions and helpful hints on welding. Be sure to ask for your free copy.

AMSCO "Wear-Sharps" are available in two quickly and easily installed types:

Crescent Back
For application to worn tooth with minimum fitting.

Straight Back
For application after worn tooth is beveled.

U. S. Pat. No. 2,247,202

New AMSCO "Wear-Sharp" repointer holds a straight edge as it wears . . . and stays sharp longer!

Here's a new tooth repointer that is just what you've been looking for . . . the AMSCO "Wear-Sharp", *and it does exactly what the name implies.*

Note the groove design on this new repointer shown above. The outside and end grooves are AMSCOATED with Amsco Hardfacing Electrodes specially recommended for this purpose, while the inner grooves are left as they are. Result?

The Amscoated grooves wear slower, thus equalizing wear along the entire cutting edge and making the point stay sharp longer. Rounded, blunted corners that cut digging efficiency and waste power are completely eliminated for the life of the repointer!

The "Wear-Sharp" is already setting new records in service life and digging efficiency. For example, an Eastern mine reports *6 times longer service than any repointer ever used before.*

The next time your dipper teeth need repointing, try the new "Wear-Sharp"! Write today for illustrated catalog shown at left—and name of your nearest AMSCO Distributor.

AMSCO WELDMENTS
THE RIGHT WAY TO MAKE REPAIRS

Brake Shoe **AMERICAN MANGANESE STEEL DIVISION**
382 EAST 14th STREET • CHICAGO HEIGHTS, ILL.

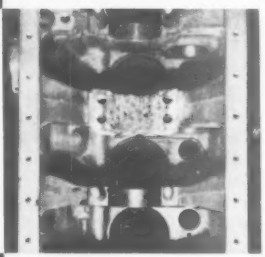
Other Plants: New Castle, Del., Denver, Oakland, Calif., Los Angeles, St. Louis. In Canada: Joliette Steel Division, Joliette, Que.

Don't scrap that casting

New Welding Technique
...salvages cast iron crank cases with scored bores

Scored or pinched bores used to mean the scrap pile for cast iron crank cases. But that's not so in service departments of Autocar Company branches since they installed a new salvage-by-welding technique. Here's how it's done —

1 Welder deposits a layer of Ni-Rod "55" in center brace bore, while crank case bolted to block rests in upside-down position. This crank case bore hole had previously been machined down about .045" to remove scored area and eliminate oil-impregnated cast iron material. Fast work prevents store-up of excessive heat in cast iron brace.



2 Finished weld deposit has one-bead thickness. Using a ⅛" dia. Ni-Rod "55" electrode, the welder first deposited metal around the oil holes, then laid beads lengthwise in the bore, working from center outward and on alternating sides.

3 Now for the machining: The bearing cap is placed in a fixture. The joint surfaces are ground smooth and in parallel, then securely fastened in place. A special boring bar (bar held in perfect alignment with the other bores) and Carboloy-tipped cutting tool machine Ni-Rod "55" deposit down to the original dimensions. (Tolerance is held to 0.0005 in.)

4 As good as new. After machining, the bore's smooth new surface of weld metal is ready to receive the new bearing. Then the crank case is ready to be assembled. The first case salvaged this way has been in continuous service for over two years now, giving perfect service.

...you can save it with Ni-Rod®

There's one thing you know about increased defense production. As many broken or damaged castings as possible must be salvaged.

And with the proper techniques and equipment you can do just that.

With Ni-Rod and Ni-Rod "55", for example, you can make sound machinable welds in cast iron.

Welds that will restore equipment to essential production and at the same time save the cost of replacements.

And Ni-Rod is easy to use, too. Even a welder with limited experience can quickly learn to lay high-strength, sound, non-porous, machinable welds. Pre-heating or post-heating are seldom required.

For information on how to use Ni-Rod and Ni-Rod "55" for machinable welds in cast iron, write for your free copy of "Ni-Rod, an electrode for any cast iron welding."

And remember, defense production requires a lot of Nickel and Nickel alloys. Therefore, it may take longer to get the Ni-Rod you want. But, you can help speed delivery of your order by including the D.O. or C.M.P. rating. Consult your distributor on present availabilities; he will be glad to keep you posted. And you can call on him for technical information too.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

EMBLEM OF SERVICE
INCO NI-ROD

Write today for your free copy of "Ni-Rod, an electrode for any cast iron welding."

CUT CONTOURS 4 TIMES FASTER
IN HEAVY METAL PLATE
with NEW BAKER SHEAR!!

BAKER
DOES ALL THESE JOBS
Quantity 3, no template required.
Quantity 85, save time with template—no layout required.
Beading operation, entirely within sheet—compare with other methods.
Inside cuts, no starting hole required.
Inside cut, no metal removed—parts will mate when finished.
This job was cut in 22% of time of previous method.
Custom or low-quantity beading done with low tool cost.

SAVE TIME 5 WAYS!

Do your heavy duty cutting *faster and better* with the Baker Tru-Edge Contour Shear! It reduces operating time to less than ¼ of the time required on previous machines—as shown by actual cases on record because:

- ★ FAST CUTTING . . . 10 to 36 ft. per minute.
- ★ BURR FREE EDGE . . . No finishing required.
- ★ NO TEMPLATE NEEDED.
- ★ NO STARTING HOLE for inside cuts.
- ★ Cuts various thicknesses without adjusting machine.

Capacity: 6 gauge in mild steel, 7 gauge in stainless steel. Simple in design, only 5 moving parts. Versatile—does many jobs with speed and accuracy. Saves labor. Baker-built dependability.

WRITE . . . for illustrated bulletin and price

BAKER BROS., Inc., Toledo, Ohio
Makers of Better Machine Tools . . . Since 1867

The Tru-Edge Contour Shear is made by Baker Bros., Inc., under license from Industrial Devices Corp., Detroit, Mich.

Take advantage of exclusive P&H AC Dial-lectric principle

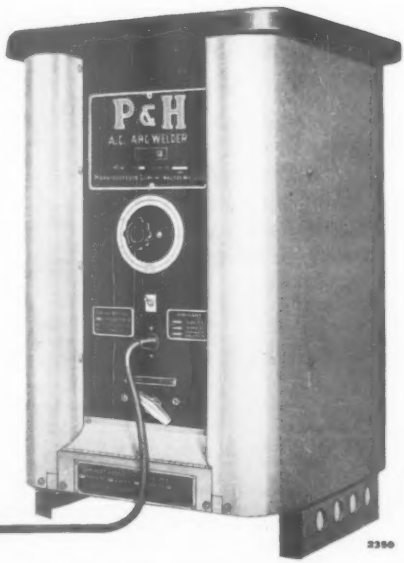
give your production a lift

— with safe, open-circuit voltage . . . easy, quick-start arc . . . time-saving, built-in remote control . . . compact AC design

Armor plate welding calls for low-hydrogen or stainless steel electrodes. P&H, pioneer in the low-hydrogen field, also offers the AC welder that gives you the best weldability with these rods — for greater production.

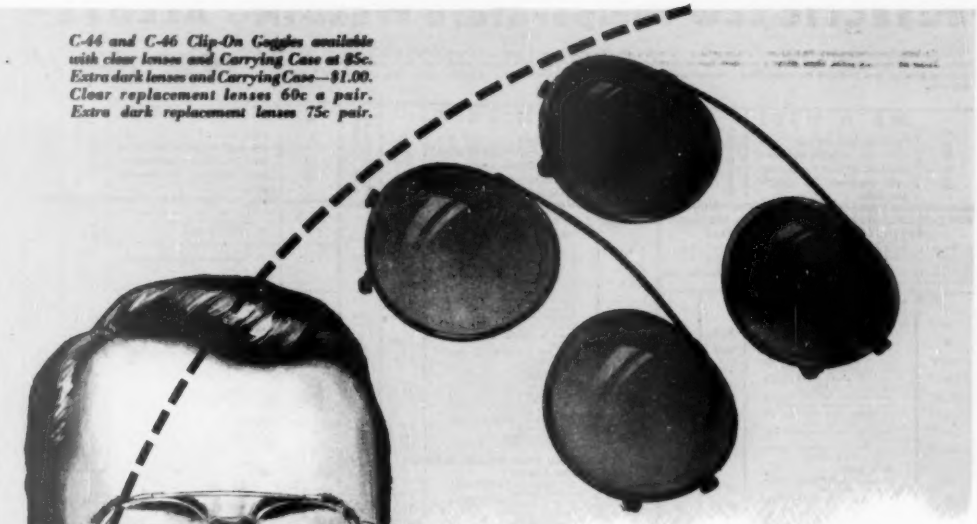
Your men like the P&H AC Dial-lectric — like its safety under the most adverse conditions; like the easy, quick-start arc, the elimination of arc-blow. And they get more done! Get sounder, better looking welds in less time, thanks to built-in remote control which lets them select the right heat at the work, turns *walking time* into *welding time*.

Because these welders give production such a lift, P&H has stepped up its delivery schedules to meet defense demands without delay. Get your production rolling in high gear. Order your P&H AC Welders today. Capacities up to 650 amps. Take advantage of this delivery situation while it lasts.



P&H WELDING DIVISION
4513 W. National • Milwaukee 14, Wis.
HARNISCHFEGER CORPORATION

C-44 and C-46 Clip-On Goggles available with clear lenses and Carrying Case at 85c. Extra dark lenses and Carrying Case—$1.00. Clear replacement lenses 60c a pair. Extra dark replacement lenses 75c pair.



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CLIP-ON GOGGLES

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For protection against glare, choose green, absorptive Clip-On lenses. Available with frames or as replacement lenses, absorptive or clear, in 44 and 46 mm. sizes.

NEW CLIP-ON CARRYING CASE

Save **real money by ordering direct from one of America's oldest manufacturers of precision lenses.**

PENNSYLVANIA OPTICAL COMPANY READING, PA.

Known for Fine Ophthalmic Products Since 1886

**PENOPTIC is the trade name of Pennsylvania Optical Company*

"EUTECTIC Low Temperature WELDING ALLOYS"®

"Eutectic Low Temperature Welding Alloys" are proprietary alloys. Their inherent feature is that of maximum surface alloying with the parent metal below its melting point. These alloys thus insure better weldability and joints of higher physical properties than those obtained with conventional welding, brazing, and soldering materials. Free Consultation-Demonstration anywhere, anytime. For larger complete chart, contact your local District Engineer.

1952 Chart!

ROD NO.	MAIN USES — Rods marked with an * are the most versatile and most popular. Others are special rods designed for specific purposes.	MELTING TEMP.°F. (approx.)	TENSILE STRENGTH* (x1000, psi (approx.)
FOR CUTTING, CHAMFERING, PIECING, GOUGING, JOINT PREPARATION OF *ALL METALS*			
	CutTrode 1 (Universal)—Ideal for cutting, chamfering, gouging, piercing steel, copper, aluminum, nickel, preparing cast iron for welding. CutTrode G (Gouging) — Developed primarily for gouging and chamfering.		
FOR CAST IRON			
	FOR TORCH		
11FC*	All purpose, high strength, easily machinable	1400	25-30
141	All purpose (same as 14 without coating;	1400	25-30
142FC	"Anti-Porosity" coated; easy to use; machinable	2650	45
140	Nickel cast iron; high strength cast iron	1400	35
146FC	Bronze-type rod for ferrous and non-ferrous metals	1400-1625	60
15	Sealing and filling of cracks, defects, etc.	450	54
165FC*	Bronze welding and for overlay	1400	5
146FC	For Bronze welding; extra-high wetting action	1400	60
	FOR ARC		
24*	High strength "cold" welding; machinable	AC-DC	50-55
25	High strength, machinable; for alloy cast iron	AC-DC	55
24B	Where cast iron filler is desired (preheat)	AC-DC	60
26	All purpose—high strength	AC-DC	35 60
FOR ALL STEELS			
	FOR TORCH		
16FC	All purpose, high strength, low melting	1400-1600	100B
1600	Medium low melting	1425M	100B
1601	High strength; for tungsten carbide	1230M	100B
1800	Special Ferrous and non-ferrous	1150M	100B
1801	Alloys Lowest melting; high speed steel	1120	—
1807	For extra-high remelt temperature; silver alloy	1700M	13-32B
70	For repair and maintenance; contains chrome-nickel	AC-DC	82
*1	For production of chromo-moly steel assemblies	AC-DC	100
	For low melting solders, refer to EutecRod 150, 151, 151B, 153, 185 listed under "Copper, Brass, Bronze". They can be applied to steels with equal success.		
	FOR ARC		
60	All purpose, thin sheet.	AC	63-72
600	mild steel	DC	63-72
66*	High strength, low alloy	AC	80
660*	steel, cast iron	DC	70-75
67*	All purpose, high strength,	AC	70
676*	alloy steel	DC	90
68	For carbon, spring, tool &	AC	95-100
680	die, and higher alloy steels	DC	95-100
6600	For upband welding, of mild steel; poor fit.	AC-DC	72
Hand-Omatic	For "contact" welding; less	AC-DC	72
Steel-Tactic	fatigue, higher speed Low amperage, "non-stop" electrode; high strength	AC-DC	70-80
FOR STAINLESS STEELS			
	FOR TORCH		
StainRod A (FC)	For gas welding stainless; high strength	—	80
	FOR ARC		
StainTrode A	Type #301, 302, 304, 321 and 347	AC or DC	85
A Mo	Moly, all purpose type #302, 315, 316, 317 and 329	AC or DC	82
B	All purpose type #301, 302, 304, 305, 306 and 308	AC or DC	83
B Mo	Moly, for types # 303, 308, 315, 316, 317 and 329	AC or DC	83
C	All purpose type #309	AC or DC	91
D	All purpose type #310	AC or DC	92-95
FOR COPPER, BRASS, BRONZE			
	FOR TORCH		
18FC*	Universal uses, high strength	1400-1600	55
180	Substitute for silver solders	1290	—
181	Medium low melting, ferrous and non-ferrous	1300	—
1800	Lowest melting	1150M	100B
1801	High strength joints	1120	—
1803	Special Silver Alloys Silver alloy; extra-high remelt temperature	1185	140
1807		1700M	26B
1805	Silver bearing brazing-type alloy; high strength	1400-1600	65
183FC	Weld thin and medium copper sections	1930	34-38
184FC	Weld heavy copper sections	1960	34-38

ROD NO.	MAIN USES — Rods marked with an * are the most versatile and most popular. Others are special rods designed for specific purposes.	MELTING TEMP.°F. (approx.)	TENSILE STRENGTH* (x1000, psi (approx.)
FOR COPPER, BRASS, BRONZE (cont.)			
	FOR TORCH (Cont.)		
150	High melting solder, filler for defects	600M	—
151	Lowest melting solder applications	350-400M	—
151B	Lead-free solder type alloy for steel, copper, nickel	425-450 M	—
153	Tin free solder applications	575M	—
155	For ferrous and non-ferrous; stronger than solder	725M	—
182	Low melting; Ideal for thin sheet or tubing; good color match	1800	45
800	Low cost substitute for silver solder	1310	—
	FOR ARC		
28*	All purpose brass and bronze	AC	45
280*	All purpose brass and bronze	DC	45
29	All purpose silicon and high copper bronze	AC	45
290	All purpose silicon and high copper bronze	DC	45
30	All purpose for copper	AC	32
300	All purpose for copper	DC	32
FOR NICKEL AND NICKEL ALLOYS			
	FOR TORCH		
20FC*	All purpose, high strength — Free flowing	1400	60
200	Special low melting silver alloy	1220	—
	For low melting solders, see 151, 153 (copper listing).		
	FOR ARC		
2000	For Monel; high strength; corrosion resistant	AC-DC	65
2001	For Nickel; for corrosion-resistant weld	AC-DC	50-55
FOR ALUMINUM AND ALUMINUM ALLOYS			
	FOR TORCH		
190	T-joints, fillets, lap joints; thin sheet	1000	22-24
190B	Extremely low melting, joining and filling	350M	—
210FC	Cast and sheet aluminum; high strength	1075	20
19	Low melting; filling defects	675	—
21FC	Best for butt joints, sheet, tubes, shapes	1075	20
22FC	Non-silicon rod, perfectly color-matched welds on 2S, 3S	1175	14
	FOR ARC		
2100	All purpose, sheet and cast-ing	DC	20
2101	Highest strength electrode; easy-to-control; fume-free	DC	34 (on ST)
2102	Silicon-free; highest corrosion resistance; anodizable	DC	15
FOR MAGNESIUM ALLOYS			
	FOR TORCH		
1900*	High strength for sheet, tubes, shapes	1110	29
1902	Ideal for thick-to-thin welds; flows like silver	1100	25
FOR ZINC DIE CASTINGS			
	FOR TORCH		
196	Ideal for repairs of carburetors, grilles, etc.	675	17-24
FOR HARD OVERLAYING—EUTECHROM GROUP FOR MAXIMUM HARDNESS			
	FOR TORCH		
1FC	All purpose—unmachinable		Carbides C50-60
11FC	High abrasion, oil drill tools, etc.		Carbides C50-55
13FC	Cast iron, cast steel, etc.		C55-62
188FC*	Ferrous and non-ferrous		
2B FC	All purpose—machinable		C20-32
3FC	Manganese steel		20
5 OH FC	For oil hardening steels; heat treatable		C56-61
5 HSS FC	Cutting edges—heat treatable		C58-62
5 HW FC	Heat treatable alloy for hot working tools and dies		C45-52
5 AH	Hard "as deposited"; against severe abrasion		C58-60

ROD NO.	MAIN USES — Rods marked with an * are the most versatile and most popular. Others are special rods designed for specific purposes.	GENERAL APPLICATION	HARDNESS, ROCKWELL*
5 WH	Can be quenched to high hardness in water or "Eutec-Brine"	WATER HARDO TOOLS	C60-63
7 FC	All purpose, against corrosion	CORROSION	C48-54
	FOR ARC		
2	All purpose—unmachinable	AGAINST ABRASION	C50-55
2X	For all-around use; good corrosion resistance		C55-60
10	For severest wear; high hardness at high temperatures		C63-68
12	High abrasion, oil drill tools etc.		Carbides C50-55
130	Cast iron, cast steel, etc.		C55-62
1880*	Ferrous and non-ferrous		
2B	All purpose—machinable	AGAINST IMPACT	C20-22
4	Manganese steel; work hardening		B90
6 OH	For oil hardening steels; heat treatable		C56-61
6 HSS	Cutting edges—heat treatable	HIGH SPEED STEEL	C58-62
6 HW	Heat treatable alloy for hot working tools and dies	HOT WORK TOOLS	C45-52
6 AH	Hard "as deposited"; against severe abrasion	AIR HARD'G TOOLS	C58-60
6 WH	Can be quenched to high hardness in water or "Eutec-Brine"	WATER HARD'G TOOLS	C60-63
8	All purpose, against corrosion	CORROSION	C48-54
	For tough, machinable, heat resistant overlays, see 67, 68 (all-steel listing)		BRINELL
	BRONZOCHROM GROUP (TORCH ONLY)	FOR TOUGH MACHINABLE OVERLAY	
185FC	High strength; all purpose steels		130-140
186	All purpose — harder than 185FC		150
187	Very hard, copper alloys		175-185

EUTECRODS—"500 SERIES"—For Inert Gas-Shielded Arc Welding

501—For aluminum, t.m.
502—For aluminum sheet, m.t.
503—For pure aluminum, c.r.
509—For all bronzes, m.t.
510—For silicon bronze, c.r.
511—For copper, c.r.
512—For copper alloys, m.t.
513—For light copper, t.m.
520—For monel, c.r.
521—For nickel alloys, c.r.
530—For magnesium, m.t.
531—For magnesium sheet, t.m.
565—For stainless steel, c.r.
571—Hard overlay cast iron
572—Hard facing steel
573—Machinable overlays, c.r.
574—Overlay, manganese steel, c.r.
575—Overlays, tool steels, c.r.
580—For monel, c.r. Heat-resistance, t.m.
588—For cast iron repairs, c.r.

CODE: t.m. = low-melting m.t. = medium-low melting. c.r. = corrosion resistant, same as parent metal.

CHEMICAL WELDING AND BRAZING AIDS—

"Form-A-Jig" — Holds small sections, avoids jig-making.

"Instant Hardner #2"—Hardens any steel with ordinary torch.

Pre-Cleaners for Aluminum, Magnesium — Insure porosity-free, sound bonds.

"Eutecto-Mask" — Protects parts against heat, spatter, etc.

"Instant Hardner #2"—Same as #1 but with hard particles.

Post-Cleaner for Aluminum — Removes welding residue.

"Anti-Capillary Compound"—Base-welding alloy; insures neater joints.

"Eutec-Brine" — Brine-type solution—for heat-treating, quenching.

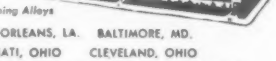
"Eutec-Mark-A-Cut" Pencil—Draws guide lines on hot or cold metal.

Specially Compounded Fluxes for all metals.

1. FC means ready-flux-coated. Also available bare.
2. The base metal temperature required in the weld area to obtain a bond. Applies to beveled joints and overlay. "M" after the value shown signifies "melting point of alloy."
3. All values are "as deposited" and can at times be increased by heat-treatment. Tensile strength also depends on joint design and condition of base metal. "R" after the value shown signifies shear strength, psi.

* Most popular rods for everyday use.

EUTECTIC WELDING ALLOYS CORPORATION
172nd STREET AND NORTHERN BLVD., FLUSHING-NEW YORK, N.Y.



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Twice the belt life in weld grinding!

Try the one simple change in your present backstand or swing frame set-up. Using the same grinder, the same type of abrasive belt by CARBORUNDUM, remove the contact wheel and replace it with our new serrated rubber "61" wheel.

Put the machine back to work. See for yourself how stock removal rates go up, how much longer the belt cuts, how belt changes are reduced. Watch for a better finish, less fatigue from your operator. Best of all, check your abrasive costs. They may be as much as 50 per cent less. See your CARBORUNDUM representative or distributor about the new "61" wheel. Or write Dept. WE 82-134 for full details.

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2 NEW AO PRODUCTS

For Better Welding See-Ability!

COVER LENSES
and
COVER PLATES

NEW PLASTIC COVER LENSES

Give Longer Life . . . Reduce Fogging

Here's AO's latest in protecting filter lenses from spatter in welding and burning operations. Made of thin cellulose, center portion of lens is raised to permit a space between it and the filter lens — thus a fiber washer is not needed to separate the lenses. RESULT: THIS AIR SPACE BETWEEN LENSES CREATES A NEAR VACUUM THAT AUTOMATICALLY *REDUCES FOGGING TO A MINIMUM.*

The No. 162 LASTS LONGER, too — won't break when dropped — won't crack because shock-absorbing acetate cushions the blow.

QUICK FACTS

- Sparks bounce off without damage.
- Resists fusion of hot metals—deflects spatter.
- Remains pit-free longer than glass.
- Clear acetate allows clear vision.

NEW PLASTIC COVER PLATES

Give Thrifty Protection Against Pitting and Scratching

These clear, hard plates (AO No. 168) compare in smoothness and lustre with polished plate glass. Superior resistance to abrasion makes them ideal protection against pitting by welding spatter. Long lasting — easily cleaned.

YOUR NEAREST AO SAFETY PRODUCTS REPRESENTATIVE CAN SUPPLY YOU.

QUICK FACTS

- Optically correct.
- Clear — won't discolor under ordinary welding conditions.
- Protects against eye fatigue — boosts production.
- Won't peel, blister or shrink in service.
- Highly resistant to breakage.

American Optical
SAFETY PRODUCTS DIVISION

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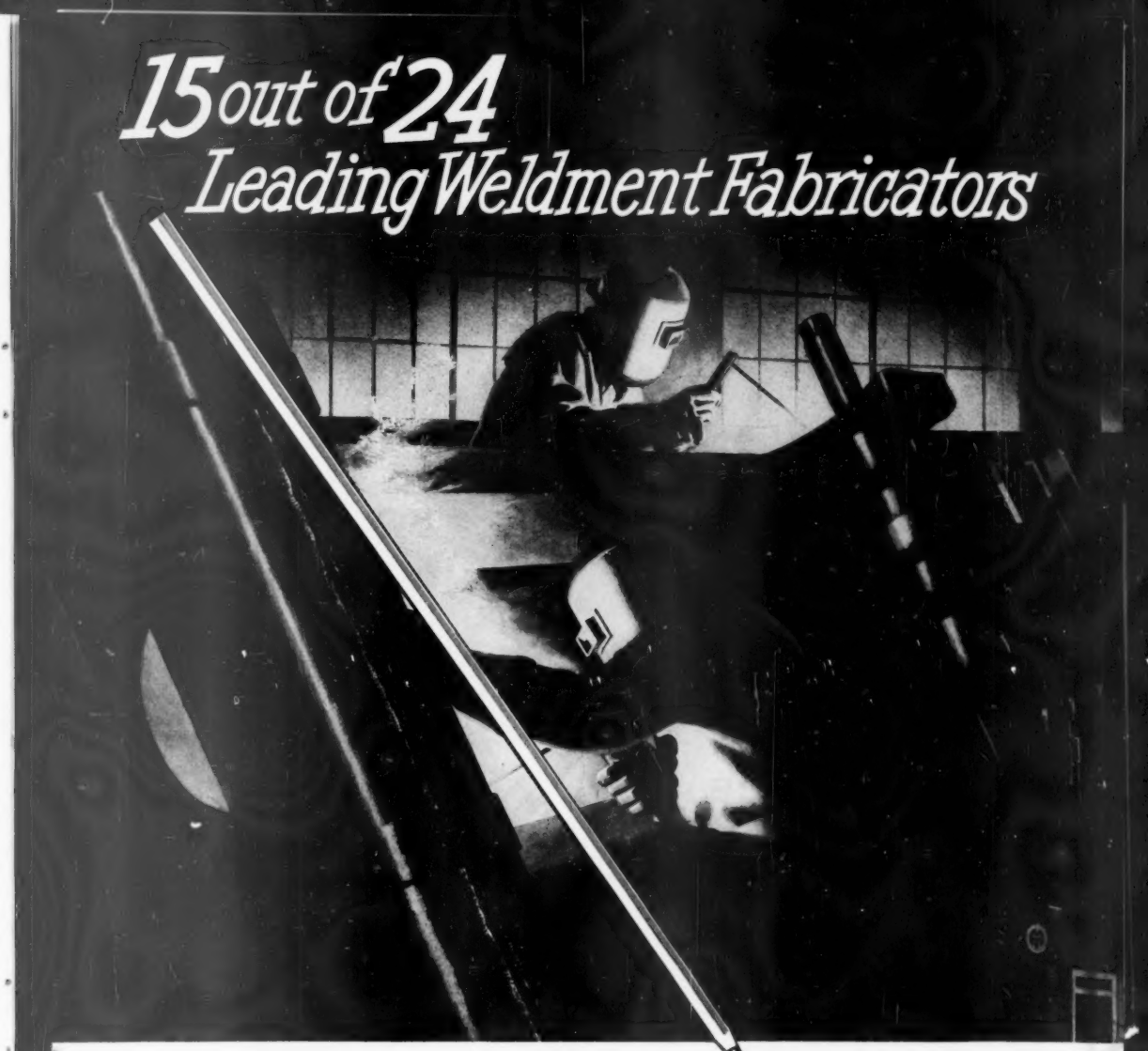
15 out of 24 Leading Weldment Fabricators



*Among the twenty-four *top contract welding firms, fifteen regularly weld with Murex Electrodes.*

More of the leaders in important industries prefer Murex Electrodes in their welding operations because they can be sure of sound welding—high deposition rates for economy and speed of production.

*Those having AAAA directory ratings.

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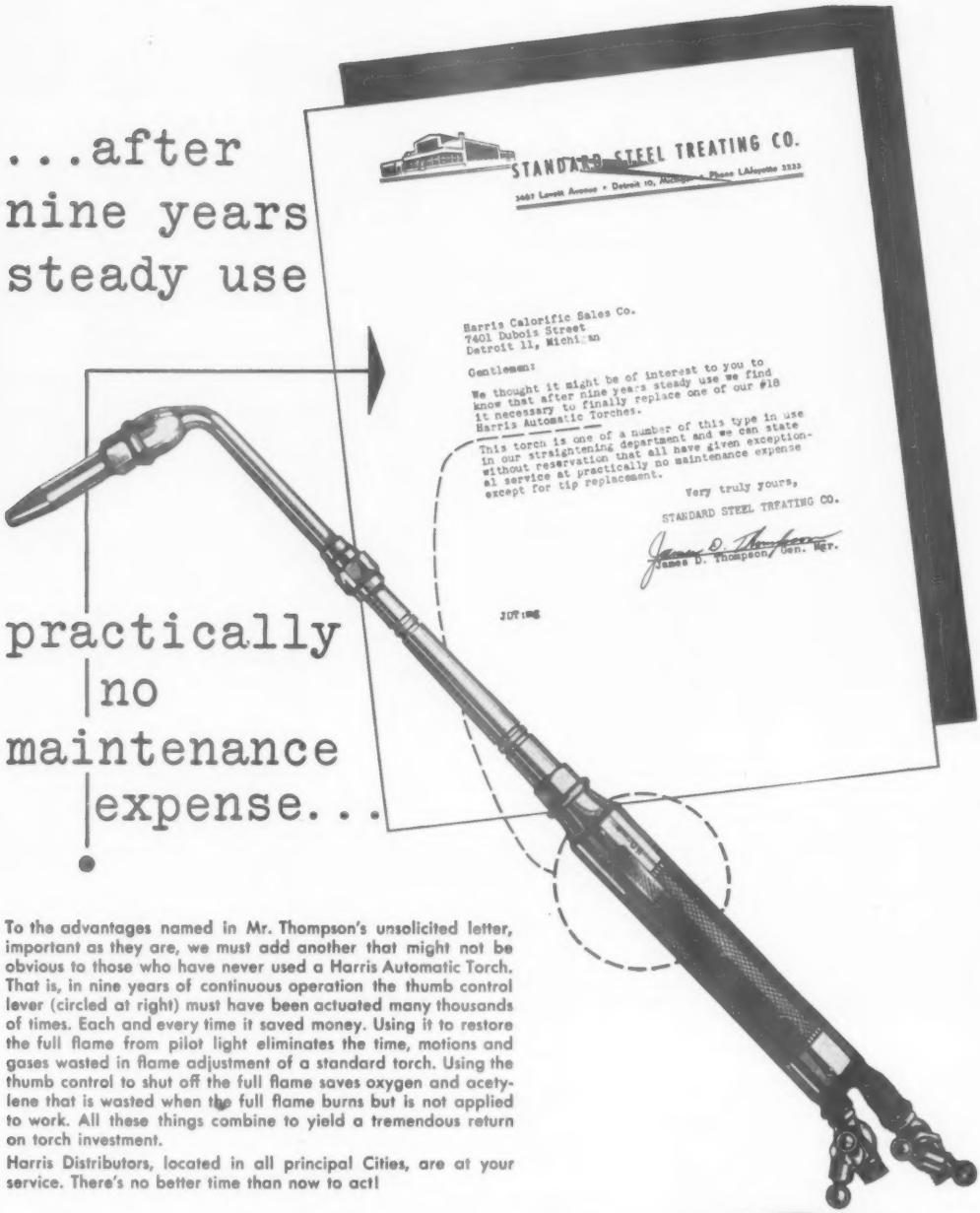
STANDARD STEEL TREATING CO.
Harris Calorific Sales Co.
7401 Dubois Street
Detroit 11, Michigan
Gentlemen:
We thought it might be of interest to you to know that after nine years steady use we find it necessary to finally replace one of our #18 Harris Automatic Torches.
This torch is one of a number of this type in use in our straightening department and we can state without reservation that all have given exceptional service at practically no maintenance expense except for tip replacement.
Very truly yours,
STANDARD STEEL TREATING CO.
James D. Thompson, Gen. Mgr.
JDT:MS

To the advantages named in Mr. Thompson's unsolicited letter, important as they are, we must add another that might not be obvious to those who have never used a Harris Automatic Torch. That is, in nine years of continuous operation the thumb control lever (circled at right) must have been actuated many thousands of times. Each and every time it saved money. Using it to restore the full flame from pilot light eliminates the time, motions and gases wasted in flame adjustment of a standard torch. Using the thumb control to shut off the full flame saves oxygen and acetylene that is wasted when the full flame burns but is not applied to work. All these things combine to yield a tremendous return on torch investment.

Harris Distributors, located in all principal Cities, are at your service. There's no better time than now to act!

THE HARRIS CALORIFIC COMPANY

Cleveland 2, Ohio

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SERVING THE METAL INDUSTRY SINCE 1905

Protect bucket lips, teeth, bucket sides and bottom with Stoody Self-Hardening 21! A few stringer beads as cross-hatches do the trick on large areas. Combine stringers and solid deposits at concentrated wear points. Stoody Self-Hardening 21 provides excellent wear resistance, goes on fast and easy and makes heavy deposits in one pass. For these reasons *and because it's economically priced,* Stoody Self-Hardening 21 is the ideal rod for heavy-impact, severe-abrasion. See your Stoody Dealer—600 in the U. S. and Canada—or write for complete welding procedures.

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APPLICATION: Apply Stoody Self-Hardening 21 to dipper teeth on all sides 2" up from point. Extend stringers of Self-Hardening 21 up the balance of each tooth. Where abrasion is unusually severe but impact only moderate substitute Tube Borium for Self-Hardening 21 deposits on the point.

STOODY

SELF-HARDENING 21

for
AIRCO'S 800
WELDING
TORCH

no job
too
tough

Airco's versatile 800 torch meets the demands of today's speeded-up production and maintenance schedules. Flame-cleaning . . . brazing . . . hard-facing . . . welding the heaviest sections . . . whatever the work, in the shop, you can be sure that the "800" will handle it quickly and economically.

For long life, the torch head is made of durable monel. Sturdy brass forgings and seamless brass gas tubes stand up to the roughest handling. All components require little maintenance.

The "800" is unexcelled for brazing, or for straightening and bending operations. A wide range of tips is available. By adding a cutting attachment, the Airco 800 torch can be quickly converted to cut steel from thin sheets up to 6" plate—ideal for the occasional cutting job.

Dependable performance? You're sure of it from the 800 torch, thanks to Airco's 35 years of engineering know-how. Learn about Airco's complete line of arc and oxyacetylene equipment and supplies. Get in touch with your local Airco office today. Representatives will be glad to help you with any welding or cutting problem.

AIRCO

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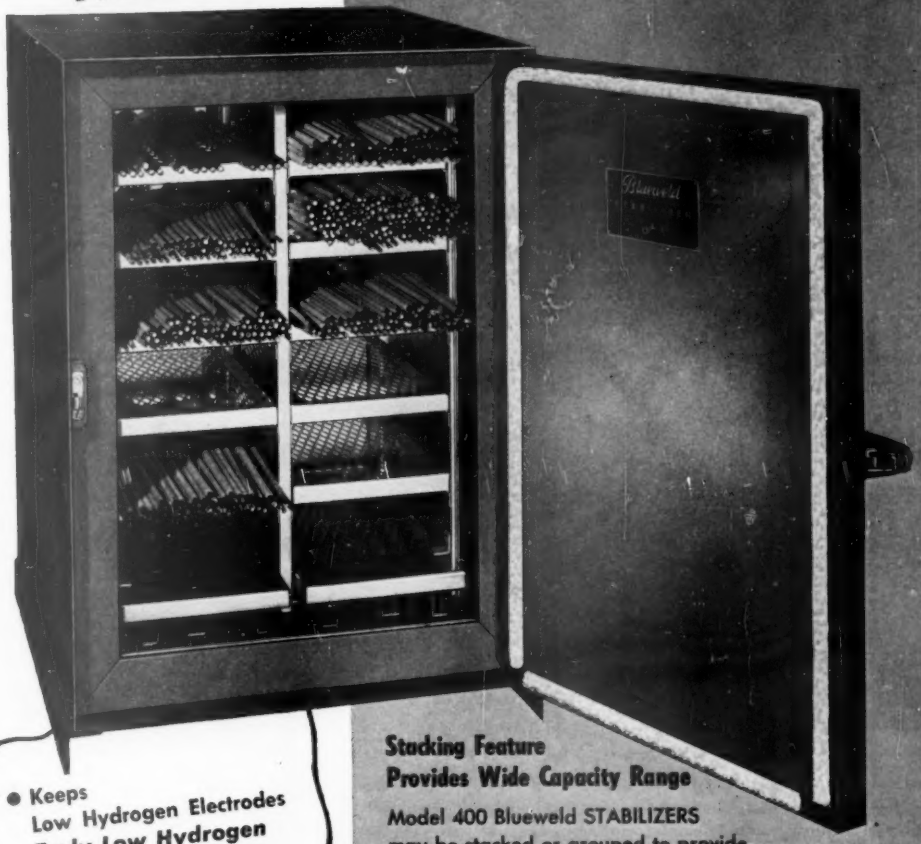
Essential to Low Hydrogen Welding...

Blueweld LO-HYDROGEN ELECTRODE

STABILIZER



- Keeps Low Hydrogen Electrodes **Truly Low Hydrogen**
- Chimney Type Ventilation
- No Dead Air Spaces Electrodes are always surrounded by Moving, Heated, Dry Air
- Pre-Set Thermostat Stabilizes Moisture Content by maintaining proper temperature

Stacking Feature Provides Wide Capacity Range

Model 400 Blueweld STABILIZERS may be stacked or grouped to provide any capacity range from 400 lbs. to 40,000 lbs., or more. As each unit is individually heated, capacity is readily and economically adjusted to varying requirements.

Specify 110 or 220 Volt Current when ordering.

Fred C. Archer, Inc.

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606 WEST WISCONSIN AVENUE

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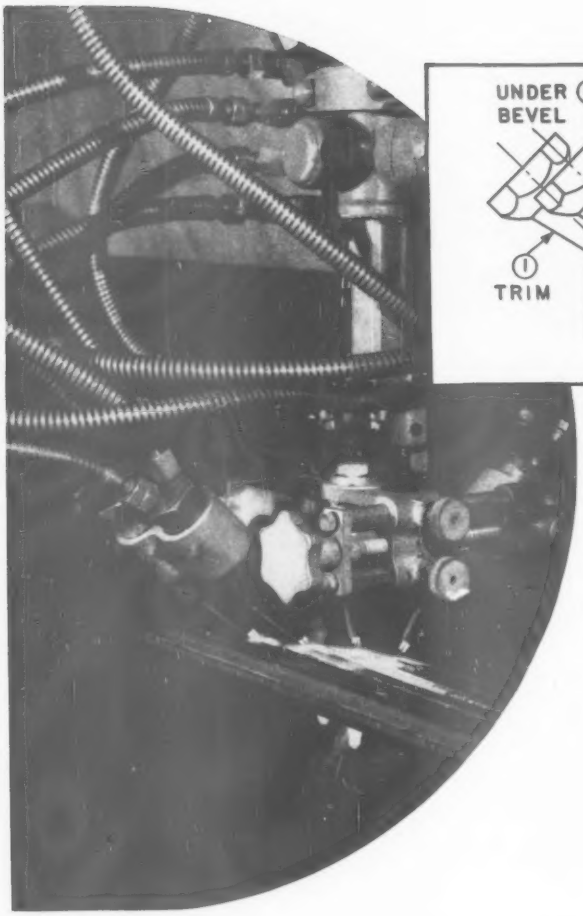

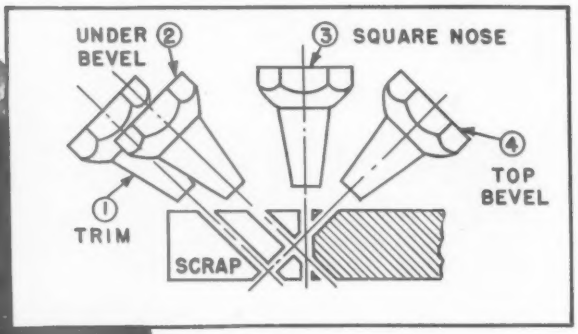

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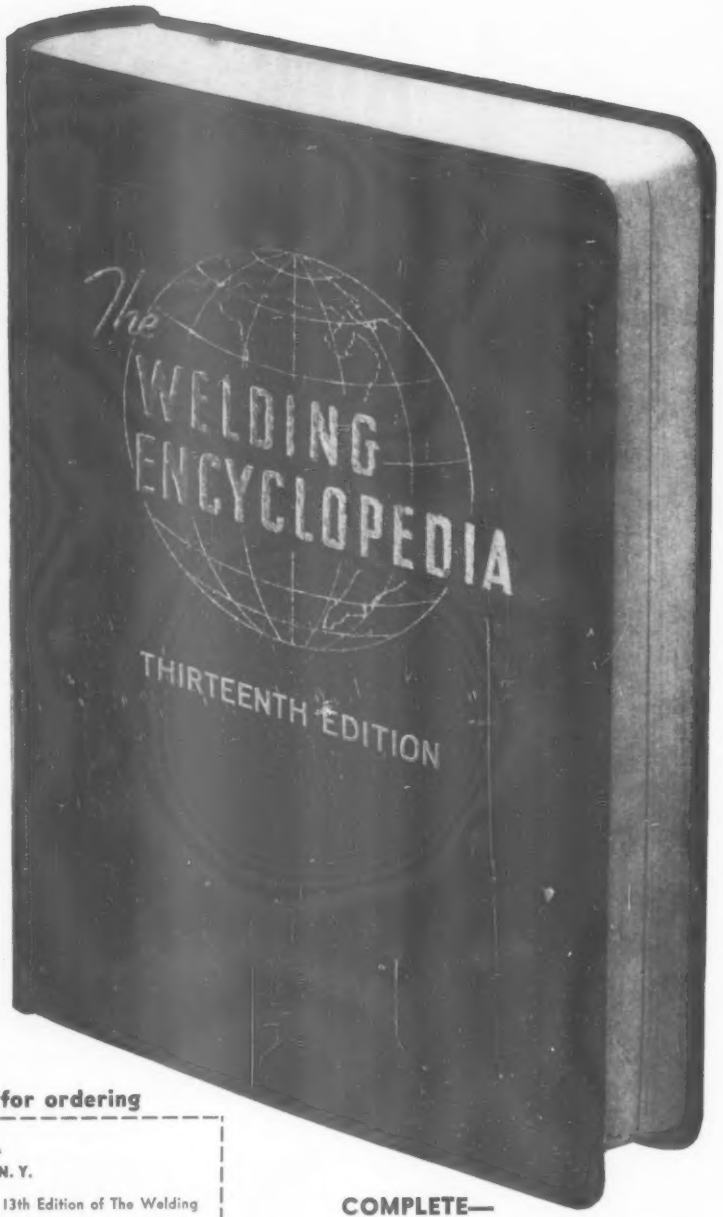

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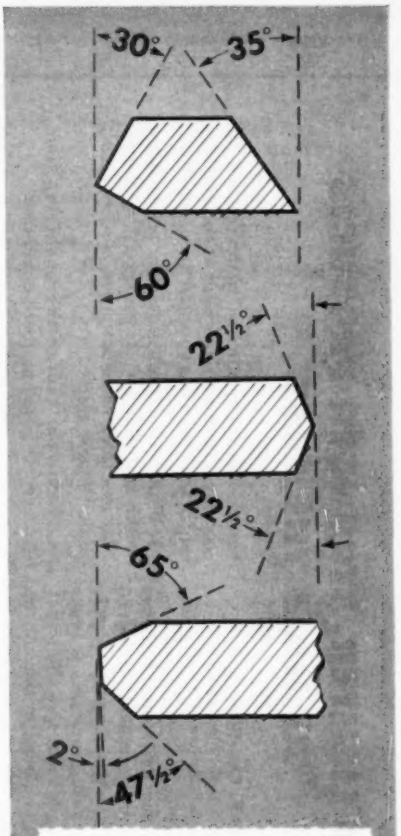

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By **Robert F. Christian,**
General Manager, J. D. Christian Engineers
San Francisco, California

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2. Shorter shop schedules are improving our own deliveries by eliminating the demand for core work formerly required on our original designs and which was not attractive to suppliers.

3. With welded construction, our products are more adaptable for use on special machines. For example, the relocating of mounting bolt holes is now easier.

4. Ninety per cent of the machining time formerly required has been eliminated.

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Fig. 1. Original Construction of gear motor housing. *Required 90% more machining.* Weighed 175% more than welded steel.

Fig. 2. Present Weldesign in Steel. *Costs 50% less.* Further saves shipping costs "prepaid" by manufacturers, using the product.

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ESTABLISHED 1916

THE WELDING ENGINEER

JANUARY, 1952

You Got a Pay Cut

THERE'S an old story about a skinflint who owned a horse. He figured that he could save himself some money if he cut down each day just a little on what the horse was allowed to eat. It worked out very well until the day when he'd got the horse's daily ration down to a single straw. That day the blamed old horse went and died.

There ought to be a moral in that for Congress.

You got a pay cut beginning the first of November. So did we, one amounting to about 2%. It's called a tax increase, but the effect is the same as a pay cut, hurts just the same when it comes to budgeting living expenses. You didn't like it and neither did we. Neither did the President of the United States, but for different reasons. The President scolds us because we are not paying enough and says that we can look forward soon to more and more pay cuts disguised under the form of higher taxes.

The pay-as-you-go system of income tax collection is supposed to make the process of milking the Great American Cow painless. Unfortunately, it works too well. Some people forget that they, too, are paying income taxes. So when one of these careless parties saw his first pay check in November, you'd hear him ejaculate, "That's not *my* check! *I* make more than that. Somebody's made a mistake."

No mistake. Naturally, when Uncle Sam's take-home gets bigger, your own take-home pay has to become smaller. Shows what can happen when Uncle is allowed to dip into your pay envelope, for Uncle seems to have developed sticky fingers.

Starting back in 1789, when our new-born nation collected its first revenue, and ending on December 1, 1951, over $531,000,000,000 have been collected in taxes. That's enough to give every one of the 155,000,000 men, women and children now living in this country a tidy sum of over $3,400.

Maybe this isn't too much to have garnered since the year 1789, but break it down by decades and you'll find what statisticians term a skew distribution. Extremely skew. Most of the big take in taxes has been in recent years. To be specific, 53% of the $531,000,000,000 was collected since July 1, 1945.

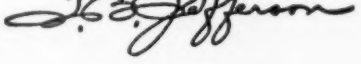
You don't believe it? We've got the figures right here. In the 156 years of our Republic prior to 1945, including the extremely costly years of World War II, tax collections totaled slightly better than $248,000,000,000. From July 1, 1945, to December 1, 1951, the amount collected was over $282,000,000,000. This means that in the last 6½ years—the years of Harry S. Truman—the Federal government has collected thirty-four billion dollars more in taxes than was collected *during the first 156 years of the United States.*

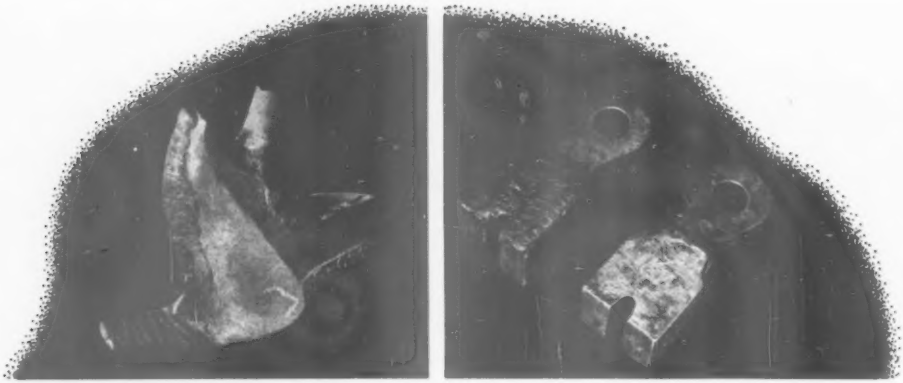
When it comes to spending, Mr. Truman is no slouch either. During the same 6½ years his administration has spent more than $285,000,000,000. Our first 31 presidents managed to spend $110,000,000,000 between them. The 32nd, Franklin D. Roosevelt, spent $364,000,000,000 in twelve years that included the most costly war in history. With only a "police action" to pay for, Mr. Truman has come within $79,000,000,000 of Mr. Roosevelt's record in a little over half the time. He can do better, he thinks. He wants to spend over $143,000,000,000 more, to bring the grand total to $428,000,000,000 for his present term of office.

Is so much spending necessary? The President never seems to ask that question: if he wants it, that's enough. The voting records of congressmen show that all too many of them are inclined to ride along with what the President wants—and to hell with the taxpayers!

Is there anything you can do about it? Yes, you can write to your senator and your representative and tell them about the horse whose ration was gradually lowered. That horse died, and the same thing can happen to taxpayers.

If you love your country, if you want America as we have known it to continue, write to your congressmen today!





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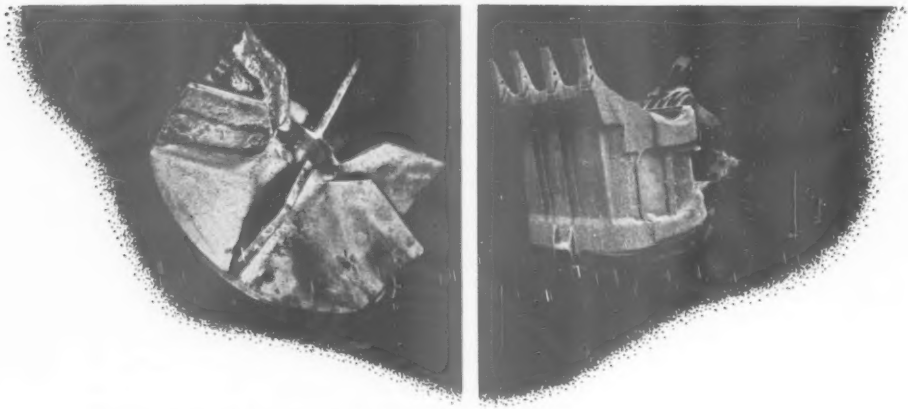

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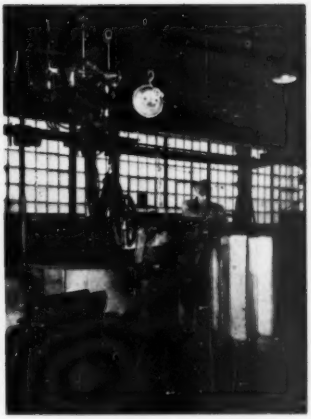
INERT-ARC welding a standing-edge joint on a rectangular tank



SPOT WELDING joins baffles to the walls of a rectangular tank

SILVER BRAZING adds the pipe fittings to cylindrical gas tanks

Ways to Fabricate

Monel Tanks for Boats

BY H. B. BOTT

Technical Service Section, Development & Research Div., International Nickel Co.

MONEL is popular for water, gasoline and fuel-oil tanks in small craft because the owner knows that with a welded Monel tank he need not worry about such things as leaking joints, contaminated water, clogged fuel lines or corrosion eating away at the tank walls and fittings.

Tank Dimensions

As a handy short cut, Tables I and II give the approximate dimensions for tanks of capacities varying from 25 to 150 gallons. Table I, for cylindrical tanks, gives tank lengths in feet for tank diameters of 1, 2 and 3 feet. Table II, for rectangular tanks, gives tank widths, depths and lengths. Naturally, other combinations of dimensions than those listed in these tables may be used.

A thinner-gage material can be employed for cylindrical tanks than is needed for rectangular tanks of the same capacity. In general, cylindrical tanks are the more economical to fabricate. Most of the discussion that follows will refer to cylindrical tanks.

The most economical Monel sheet to use for boat tanks is produced in the hot-rolled, annealed and pickled condition. For gasoline tanks of from 1 to 80 gallons, the minimum recommended thickness is 0.037 in. (20 gage, U. S. Standard). For gasoline tanks of 81 to 150 gallons, the minimum thickness is 0.050 in. (18 gage, U. S. Standard).

The 0.037-in. sheet may be joined by the oxyacetylene torch, by inert-gas-shielded arc welding or by spot and seam welding. The 0.050-in. thickness is the lightest gage recommended for metal-arc welding.

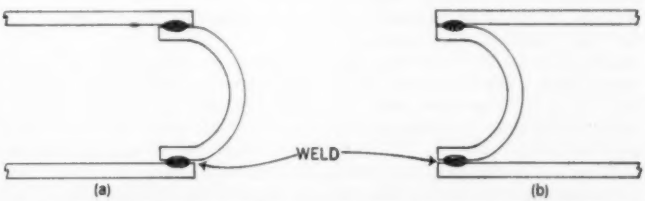
When doing oxyacetylene welding, a Monel gas-welding flux should be mixed with water to a thick, creamy paste and applied generously to the edges to be joined and to the filler wire. A slightly reducing flame is recommended; the feather of excess acetylene, however, should not be over $\frac{1}{16}$ in. long (showing beyond the tip of the luminous cone). A $\frac{1}{16}$-in. Monel filler rod should be used to weld sheets from 0.037 to 0.062 in.

Other Welding Processes

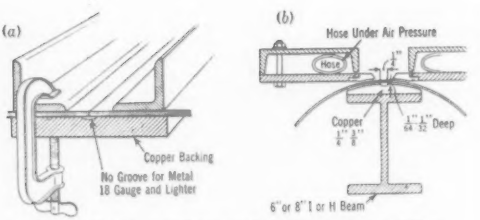
Best inert-gas-shielded arc welding results will be obtained with direct current and straight polarity. To obtain welds free from porosity, it is essential to maintain a short arc. Use a $\frac{1}{16}$-in. diameter welding wire to join sheets of from 0.037 to 0.062 in.

When spot or seam welding Monel, higher pressures and current are required than for carbon steel. To obtain sound welds, it is essential that the faying surfaces be cleansed of dirt, oil, grease and other foreign material.

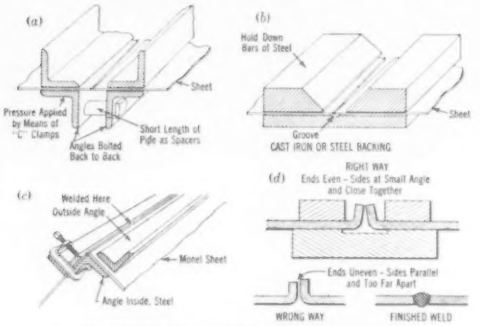
Metal-arc welding with Monel elec-



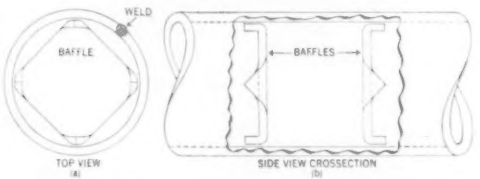
1—LAP-TYPE joints are used for seam welding flanged and dished heads to the shell. Head may be convex outside (*a*) or inverted into the tank (*b*)



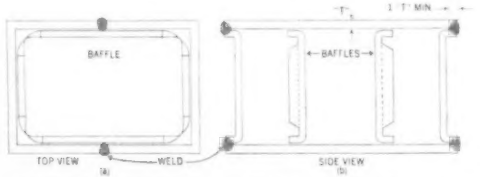
2—JIGS for metal-arc and inert-gas arc welding



3—OXYACETYLENE welding calls for these jig types



4—HOW baffles are installed in a cylindrical tank



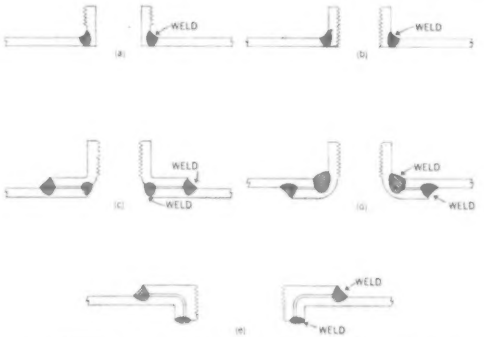
5—BAFFLES are also installed in rectangular tanks

Table I. Cylindrical Tanks

Gallons	*Tank Diameter (ft)*	*Tank Length (ft)*
25	1	4
25	2	1
50	2	2
75	2	3
100	2	4
150	2	6
150	3	3

Table II. Rectangular Tanks

Gallons	*Tank Width (ft)*	*Tank Depth (ft)*	*Tank Length (ft)*
25	1	1	3½
25	1	1¾	2
50	1	2	3½
50	1½	1	4½
50	1½	1½	3
50	1⅔	2	2
75	1	2	5
75	½	4	5
75	2	2	2½
75	1½	2	3⅓
75	1	3	3⅓
150	1½	3	4½
150	2	2	5
150	2	2½	4



6—JOINTS for attachment of pipe fittings to tanks

trodes can be done successfully on Monel sheets of 0.050 in. and thicker. Use a $\frac{3}{32}$-in. electrode for sheets from 0.050 to 0.062 in. and direct current, reversed polarity. The jigs pictured in Fig. 2 are recommended for the metal-arc and inert-gas-shielded-arc welding of light-gage Monel sheet. The fixture shown in Fig. 3 (*c*) may also be used if a copper-faced angle is substituted for the steel angle.

Monel can readily be silver brazed, a process that is recommended for the attachment of brass fittings. All commonly used silver-brazing alloys may be used except those that contain phosphorus. Fluxes should be employed as recommended by the manufacturer of the brazing alloy.

Attaching Tank Heads

There are many ways in which flanged and dished heads may be joined to cylindrical tanks. A common method is to use a butt-type joint, which can be welded by either the metal-arc, inert-gas-shielded arc or oxyacetylene process. Filler metal is required.

A lap-type joint is another good method. If the inert-gas or oxyacetylene processes are selected to do the welding, no filler metal is required; the edges of the shell are merely melted down and fused to the head. The lap-type joint may also be resistance seam welded, as in Fig. 1.

The convex side of the tank head may either be outside as in Fig. 1 (*a*) or inverted into the tank as in Fig. 1 (*b*). The inverted head can be made to provide a standing-edge joint (not shown), which may be welded by fusing the standing edges together. Use either the inert-gas or oxyacetylene process without filler wire.

AUTOMATIC inert-arc welds a longitudinal seam

SPOT WELDING flanged, dished head into a cylindrical tank

The tank shell may be made up of two cylindrical half sections. These are welded together with a circumferential butt joint, using either the metal-arc, inert-gas-shielded arc or oxyacetylene welding process. Filler metal is required. To act as a stiffener and to facilitate welding, a Monel backing ring may be used with this type of joint.

Flat heads can be attached to cylindrical tank shells only by a corner-type joint, which requires more tricky welding than either the butt joint, the lap joints shown in Fig. 1 or the standing-edge joint. The metal-arc, inert-gas-shielded-arc or oxyacetylene process may be used to make the corner-type joint; filler metal may or may not be required.

Longitudinal Seams

To fabricate a cylindrical shell, it is necessary to weld at least one longitudinal seam. For seam welding (resistance), a longitudinal lap joint is necessary. A longitudinal butt joint can be welded by either the metal-arc, inert-gas arc or oxyacetylene process; filler metal is required, and a back-up strip may or may not be necessary. With extra-good jigging, butt joints can be welded without adding filler metal and without getting any reduction in weld thickness at the joint.

The standing-edge type of joint can also be used for the longitudinal seam in a cylindrical tank. Welding may be done by either the inert-arc or the oxyacetylene process, and no filler metal is required. The standing-edge joint may also be used for the seams of rectangular tanks. Though ordinarily filler metal is not required, it may be necessary if the joint fit-up is poor.

Installing Baffles

Figure 4 shows the installation of baffles in a cylindrical tank. These are formed from square sheet sections that have a diagonal dimension greater than the tank diameter. The corners are turned up 90 degrees and welded to the shell. They may be spot welded, gas welded, metal-arc or inert-arc welded. If baffles are riveted, as is sometimes done with baffles for water tanks, a filler of either weld metal or silver-brazing alloy should be applied around the rivet heads to keep the tank leakproof.

Baffles for rectangular tanks (Fig. 5) are formed from sheet sections with dimensions larger than the tank cross-section. The corners are cut off, and the sides are turned up 90 deg and welded or riveted to the shell.

Figure 5 (*b*) also shows the proper method for welding ends into rectangular tanks. The welding is the same as that already discussed for cylindrical tanks with inverted heads and standing-edge joints. End sections for rectangular tanks may also be attached by lap, butt and corner joints. Rectangular side sections may be welded together by butt joints, lap joints or standing-edge joints, using welding processes as recommended for the longitudinal seams of cylindrical tanks.

Adding Pipe Fittings

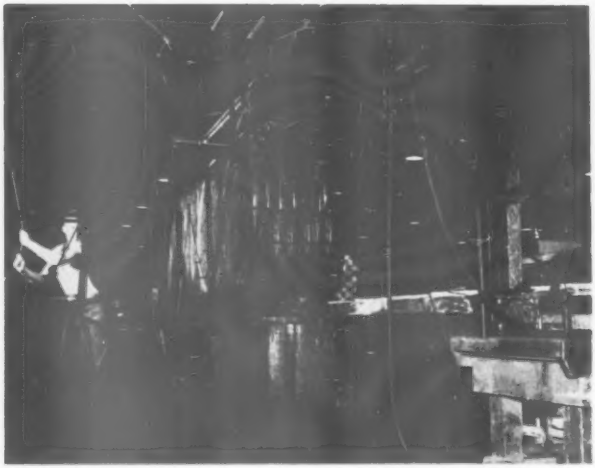
Figure 6 shows the joints recommended for attaching Monel pipe fittings to either cylindrical or rectangular tanks. Joint types *a*, *b*, *c*, *d*, and *e* may be welded by the metal-arc, inert-gas-shielded arc or oxyacetylene process, with filler metal required. If the pipe fittings are brass, the same types of joints may be used, but silver brazing should be substituted for welding. In some cases where flange-type brass fittings are to be added, both rivets and silver brazing are recommended for attachment. As an added precaution against leakage, a fillet of brazing alloy should be applied around the heads of the rivets.

Heavy jigging plates around pipe fittings will absorb heat and so help to control warpage.

To obtain the highest degree of corrosion resistance, the fittings should be of Monel and be attached by a welding process. If cast Monel fittings are to be used, it is suggested that the orders for them bear the notation: "Supply welding grade." When joining castings, it is essential that the casting skin be removed from the area that is going to be welded or silver brazed.

The welded seams should be pressure tested with air and soapsuds. Fuel tanks should be tested in accordance with the 1950 revised "Fire Protection Standards for Motor Craft," copies of which may be purchased through the Yacht Safety Bureau, 21 West St., New York City. The 1950 revised Fire Protection Standards should also be consulted for other information pertaining to the fabrication and safety requirements.

1—PRESS having a 1,500-ton capacity forms the elements of the floor beams



2—COMPONENTS are heat treated after forming in a bath of molten salts. In ten seconds, a conveyor brings them to a water quench

How Ryan Makes "Sky-Beams"

A spot weld adds no weight—and that's a big advantage for the structural beams that support the cargo-carrying floor of the big Boeing C-97 "Stratofreighter."

"Sky Beams," as the term is used at the Ryan Aeronautical Co., San Diego, Calif., are made to take the weight of the cargo-loaded floors of Boeing C-97 "Stratofreighters." These specially fabricated aluminum structural members are said to have remarkably high strength-weight characteristics. One thousand weightless spot welds are made to join together the various components of each beam.

Not so long ago, spot welding would not even have been considered for building such primary structures as floor beams for heavy aircraft. With the latest improved machines and an extensive background of resistance welding know-how, Ryan is successfully meeting the exacting military specifications that have been prescribed for the Stratofreighter's floor members.

Air Force strategists think of their big bombers as "flying gun platforms" or mobile artillery, designed to bring maximum firepower to bear against an enemy. In similar fashion, heavy cargo aircraft such as the Stratofreighter are considered to be "flying freight floors." With 6,000 cu ft of usable space, this double-decked transport can carry 68,000 pounds of freight, including jeeps, trucks and artillery. Equipment for an entire division can be airlifted across the ocean in 24 hours.

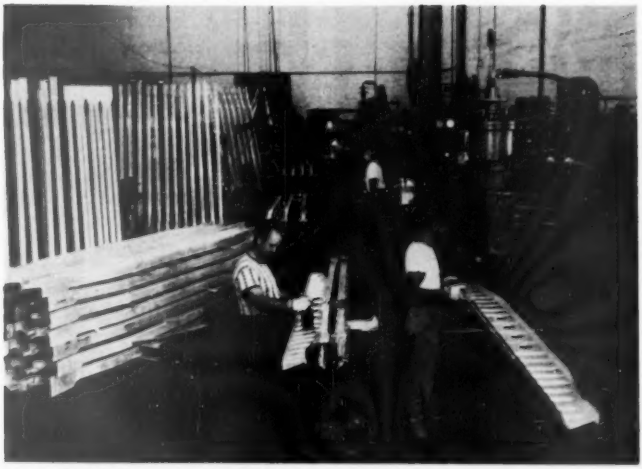
Made from clad aluminum alloy, the Ryan floor beams are built to precise measurements and handled with exacting care. First step in the production process is the cutting and drilling of the webs, channels and Z-sections from which the beams are made. The aluminum components are received in the annealed condition from the mill so that detailed forming can be accomplished more easily. A 1,500-ton hydropress is used to press out the beam structure (Fig. 1).

Heat Treating in Salt Bath

After forming, it is necessary to bring the strength and hardness of the metal up to a maximum. This is done by heating the parts in a molten salt bath (consisting of a mixture of potassium and sodium nitrates) at 925 F for 30 minutes. The temperature forces some of the elements of the metal into solid solution, producing a strong crystalline structure. Slow cooling of the metal would precipitate these elements out of solution again. In order to retain the "solid-solution hardening" at room temperatures, it is necessary to quench the aluminum within 10 seconds after removal from the hot salt bath.

D. H. Palmer, Ryan plant engineer, and his staff met the problem by designing and installing a quick conveyor system (Fig. 2). It removes the baskets of hot parts from the molten salt, speeds them to the quench tank and gently lowers them into the water—all in less than 10 seconds. Care in removal and insertion is required because the parts are soft and subject to warpage at high temperatures.

The conveyor is motivated by continuous roller chains, which are driven by a variable-speed, wound-rotor electric motor. The operator, located behind a glass enclosure, moves a switch controller to select the motor speeds desired. Ryan-designed dampeners keep the rapidly traveling baskets from swaying. The motor is equipped with a brake to permit sudden stopping.



3—BATTERY of condenser-discharge spot welders (capacities up to 2,600 microfarads) joins aluminum beam components. Quality control is important

After quenching, the beam components are cleaned for spot welding. Painstaking care is used. First they are immersed in an alkali bath and rinsed in hot water to remove soil. Then they are washed in an etchant bath of hydrofluosilicic acid to remove oxides that would increase surface electrical resistance. Ryan specifications require that surface resistance be kept below 50 microhms. To maintain this standard, spot welding must be performed within eight hours after cleaning.

Even one small particle of foreign matter can ruin a spot weld by causing an "explosion." The foreign material increases the electrical resistance, causing an accumulation of heat that melts out the metal in an explosive reaction.

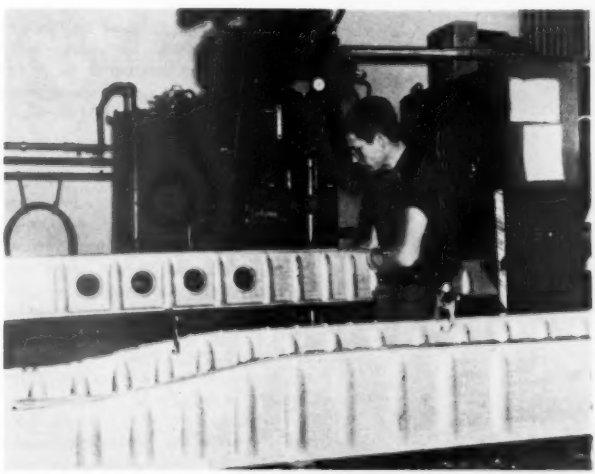
Spot Welding the Beams

Figure 3 shows the battery of spot welders employed to build the floor beams. These machines are the largest condenser-discharge welders available; they have capacities of 2,600 microfarads and can be charged to 3,000 volts. Each weld is precisely located on 0.75-in. centers lengthwise and 0.50-in. centers across the beam by means of a locating focused light. The close-up (Fig. 4) shows the spot-weld pattern of a completed beam.

The spot-welding technique saves substantial amounts of time in production and some weight. However, it must be performed with the best equipment and care. Rivets weigh more, but they can be replaced if defectively installed, whereas spot welds cannot be replaced or improved when once made. To guarantee the high standard of quality required, the performance of each machine is checked hourly by test samples, and a daily X-ray analysis of spot welds is made.

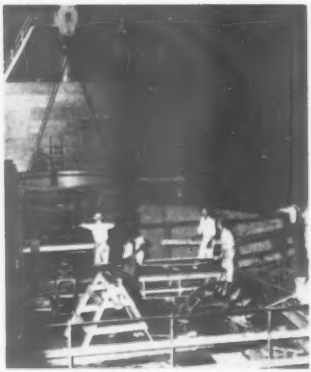
After being spot welded together, the beams are trimmed with an air-driven rotary saw to within 0.002 in. tolerance of the width. The beam widths are critical and so is the location of the attachment bolt holes, which are located and drilled to the same tolerance of 0.002 in. Finally, the entire beam is hand straightened so that it is within 0.030 in. straight for its entire length. These operations require care because 24 of the 49 beams for each Stratofreighter are of different dimensions.

Ryan installs four of the completed floor beams in each of the aft sections of the fuselage (Fig. 5) and ships the remaining 45 beams to Boeing for installation in the other fuselage sections.



4—ONE THOUSAND spot welds are precisely located in each beam, to give it maximum stiffness and strength. Photo shows weld pattern

5—RYAN employee installs four beams in the aft section of "Stratofreighter"



LOWERING LINER from assembly point on generator floor to final location (follow pictures across the two pages)

Big Welded Relief Valve

1—SHOP ASSEMBLY was made at West Allis in order to make sure that the many parts would fit together as they should when liner was installed

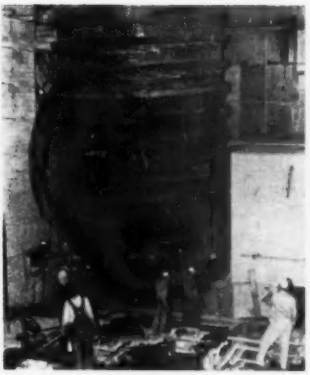
In the building and maintaining of equipment, welding continues to play a major role at Hoover Dam. Here is how a giant relief discharge liner was built and installed.

BY T. B. JEFFERSON

THE COMBINED efforts of the Allis-Chalmers Manufacturing Co. and the Bureau of Reclamation were needed to complete a 32½-ton welded pressure-relief valve discharge liner for generating unit A-4 of the Hoover Dam power plant. The parts were rolled and fitted together at the West Allis, Wis., plant of Allis-Chalmers, then shipped to Hoover Dam for final welded assembly.

The pressure-relief discharge liner houses the relief valve of the pressure regulator, which is attached to the turbine casing of the 115,000-hp unit. The valve operates from the governor so that when the turbine gates are closed suddenly the regulator will be opened sufficiently to bypass water to the Colorado River below the dam. This arrangement keeps the pressure rise to the penstock and turbine within required safe limits.

Unit A-4, along with A-3 and A-9, will complete the generating installation in the Arizona wing and will raise the total capacity of the Hoover Dam power plant to 1,249,800 kilo-



SEQUENCE VIEWS on this and opposite page show liner for the A-3 unit instead of the A-4 liner described in text

Goes into Hoover Dam

watts. There remains space for only one more generator, to be located in the Nevada wing of the plant. When this last space is filled, the total capacity of the Hoover Dam power plant will be 1,332,300 kilowatts.

Shipped Knocked Down

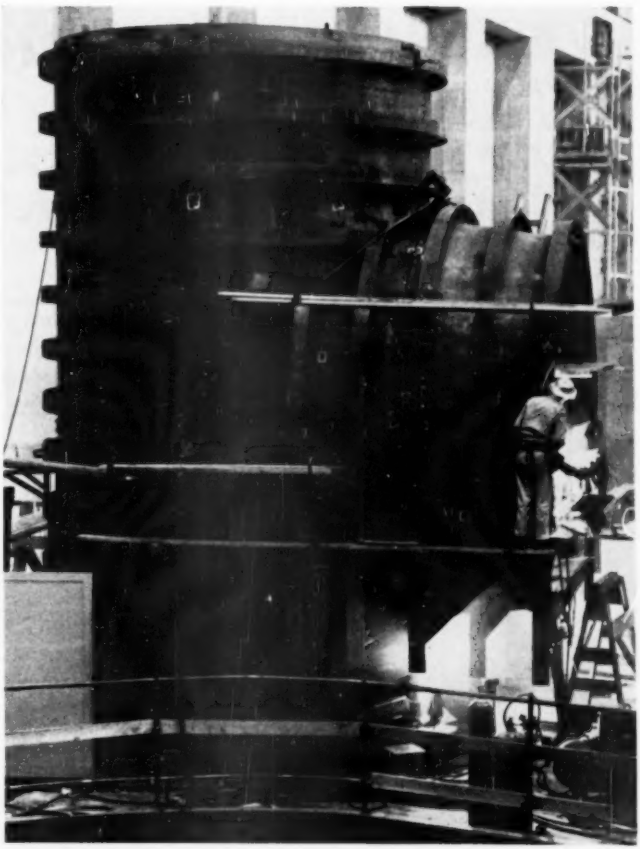
The weldment for the discharge liner weighs 65,000 lb, stands 26 ft high, measures 14 ft in diameter. Because of its bulk, it was shipped from the fabricator's plant completely knocked down. However, it was necessary to insure that the many pieces of the discharge liner would go together easily in the power plant. Hence the liner was fitted together at Allis-Chalmers prior to shipment.

The many parts were held in alignment by means of "clip plates" 6 in. long, which were bolted to the main plates of the liner. Some of these clip plates may be seen in Fig. 1. They serve a dual purpose: (1) to insure a perfect fit and (2) to function as jigs during the field assembly and welding operations. After field welding, the clip plates were removed. The bolt holes were then plug welded to insure liquid tightness.

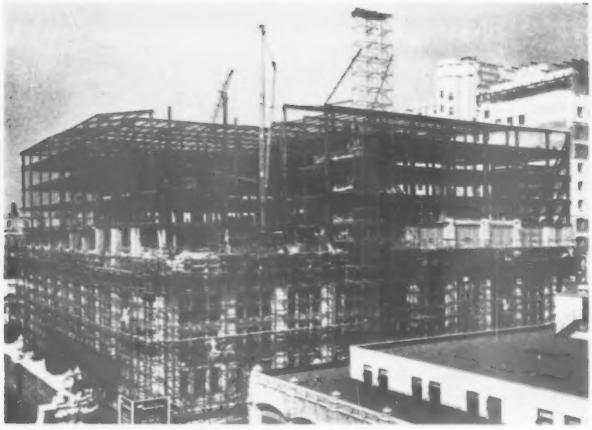
The steel rings, tees and supporting brackets on the underside of the dished steel head were completely welded in the fabricator's shop before shipment.

The liner was fabricated of ¾-in. steel plate meeting Federal Specifications QQ-S-741, Type Two, Grade A,

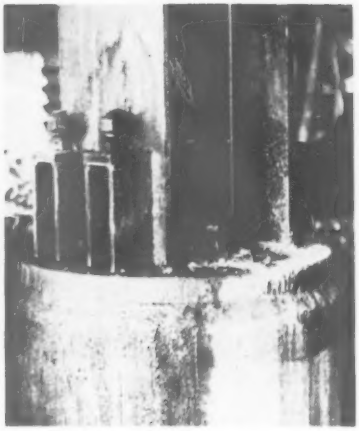
(Continued on page 47)



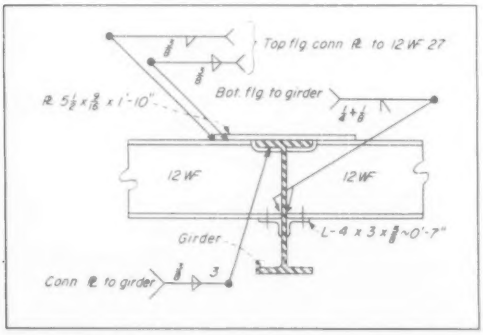
2—FIELD WELDING at Hoover Dam was done on the generator floor of the powerhouse. Liner will be installed in this position (see pictures above)



1—MOST STEEL was in place for the Frederick & Nelson department store's five-story addition at the time this picture was taken



2—BED PLATES helped anchor columns to the concrete columns of old building

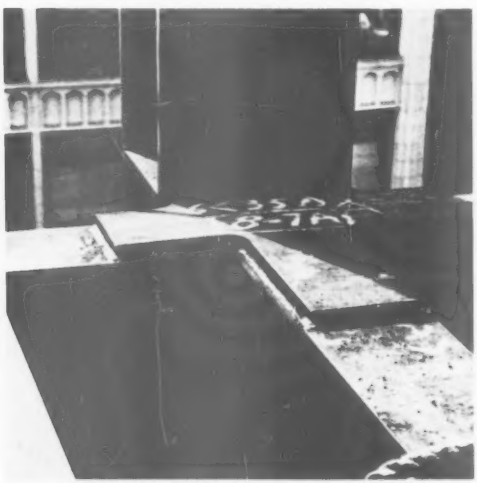


5—TYPICAL connection to join floor beam to girder

New Welded

Reinforced concrete was the most popular construction material in the Pacific Northwest. But welded steel was more economical and besides would allow an extra floor.

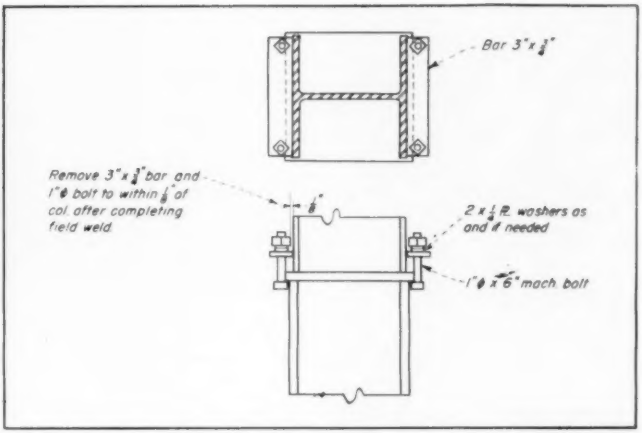
Photographs were taken by Elmer Gunnette, American Institute of Steel Construction. Figure 1 is reproduced through courtesy of Pacific Car & Foundry Co.



6—HOW SPANDREL girders are connected with exterior columns by a T-shaped upper plate 1⅛ in. thick

7—FLOOR BEAMS are linked to the girders by connecting plates having the shape of an irregular cross

3—ABOVE the eighth floor, the columns were spliced as shown here


Bar 3"x⅜"
Remove 3"x⅜" bar and 1"ø bolt to within ¼" of col. after completing field weld.
⅜"
2 x ½ R. washers as and # needed
1"ø x 6" mach. bolt

4—DETAIL of typical main column splice pictured in Fig. 3. The bars and bolts at the side were removed after the column beams had been welded

Addition to Seattle Store

By RAY BLOOMBERG

SINCE 1916, the Frederick & Nelson department store has been a landmark at Seattle, Wash. Its imposing structure occupies a strategic location in the heart of the central shopping district.

In recent years, the original five-story structure, despite 60,000 sq ft of space on each floor, became inadequate. But the store was bounded on three sides by streets and on the fourth side by a modern medical-dental building not available for purchase. The only possible direction for expansion was up.

STEEL VS. REINFORCED CONCRETE

The architectural firm of John Graham & Co. was asked to prepare plans for four additional floors. The original structure was of reinforced concrete, which has long been the most popular material for construction in Western Washington. Preliminary designs were based on a reinforced-concrete structure, until a series of detailed cost analyses disclosed that a steel skeleton with a lightweight fireproofing (as allowed under the new Pacific Coast building code) would be actually more economical than reinforced concrete.

This was a complete reversal of all previous experience: the prevalence of low-cost aggregate had formerly given concrete the edge over steel in the Seattle area. When the architects pointed out that use of steel would also allow the addition of a fifth floor (one more than was possible with concrete), the store's management was quick to decide on steel.

Weight of the structure had to be kept as light as possible. A welded rigid frame offered the logical design, effecting a steel saving of at least 7½%. Furthermore, only welding could provide the continuous connections that would offer the best protection against earthquake damage. Since the area was shaken by a severe 'quake in April, 1949, this consideration was an important one. Prof. Alfred Miller, of the University of Washington, member of the Advisory Committee on Engineering Seismology and generally considered the area's most competent authority on seismic-resistant design, confirmed the architect's selection of welded steel.

The Frederick & Nelson addition, costing around $6,250,000, is said to be the first all-welded commercial building project of any great size in the Pacific Northwest. The quietness of the welding method, contrasting as it did to the clatter of riveting on a downtown office building under construction at the same time, drew many favorable comments from the press, tenants and clients of the adjacent medical-dental building and the general public.

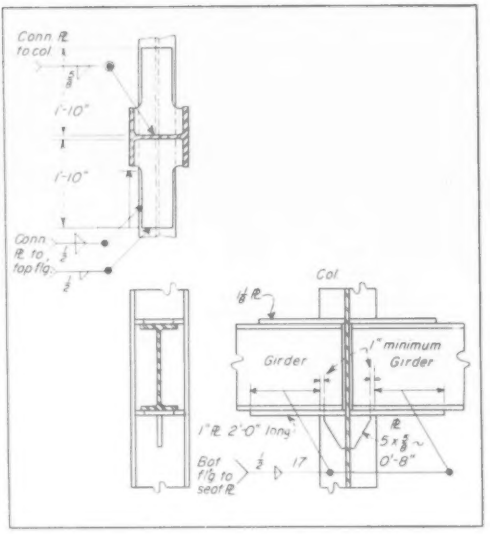
TOOK 25 TONS OF ELECTRODES

The project required about 1,900 tons of steel and about 25 tons of E-6010 electrodes, mostly 5/32 in. Steel for the columns, girders and floor beams was cut and shaped at the plant of the structural division of the Pacific Car & Foundry Co., which also did the welding. Almost 50% of the welding was done in the shop, including the seat erection clips and the girder ends of the top connecting plates, the boxes around each exterior column to support masonry and the bars on the columns for splicing.

Trucked to the site, the steel members were hoisted to the roof of the fifth floor by a stiff-leg derrick and then set into place by a 27-ton mobile crane (Fig. 1), working from the eighth floor. Since little storage space was available on the ground, the derrick and crane provided an efficient working combination.

The steel structure was set on top

8—FOR attaining headroom for the escalator opening on the seventh to ninth floors, an unusual connection was used. The two girders were bolted together (details in text)



9—DETAIL of girder to column web connection. Bottom flange of the girder is welded to the seat plate on the column, and the top flange is welded to connecting plate

of the reinforced concrete columns of the old building. Fastening of the steel columns was made through 2-in. bed plates by four anchor bolts, 1¼-in. in diameter by 43 in. long, fastened by double nuts and lock washers (Fig. 2).

The 21-in. girders were spaced 22½ ft to 26½ ft apart, as dictated by the columns in the original structure; 12-in. WF 27-lb-per-ft floor beams were spaced between the girders on 6 ft 2-in. centers. Figure 5 gives details of the floor beam connection to the girder. Width between the beams was dictated by the employment of steel forms, expandable lengthwise, in pouring concrete for the floors. These forms were supported on 2 by 6 in. timbers resting on the flanges of the beams. Removal of the timbers and forms was simple, permitting their re-use.

Since some time elapsed between erection of the frame and welding of the joints, the framework had to be protected against swaying as the result of wind action, heat from the sun and rocking motion of the mobile crane. Until welding could be completed, this was accomplished by a combination of cable and 4 by 4 in. angle bracing.

Making Column Splices

The 14-in. columns of 119 lb per ft were spliced above the eighth floor, as shown in Fig. 3. Bars 3 by ¾ in., which had previously been shop welded onto either side of the columns, were bolted together with four 1 by 6 in. machine bolts. A 1 in. butt plate was then welded with a ⅜-in. double fillet weld, after which the bar and bolt was removed to within ⅛ in. of the column. Figure 4 gives details of a main column splice.

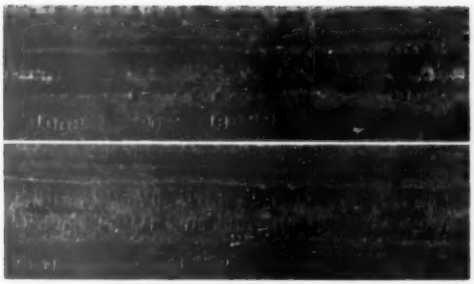
How the spandrel girders are connected with the exterior columns is pictured in Fig. 6. A 1⅛-in. T-shaped upper plate, 30 in. long above the spandrel, extends 22 in. onto the cross girder. This connecting plate is welded with a ½-in. fillet weld. Along the column flange, however, a butt weld with a 45-deg bevel (3/16-in. root opening) is used. The lower connecting plate, measuring 25½ by 32 in., is welded to the bottom flange by a ½-in. double fillet weld. The spandrel girder is welded to the cross girder with a ⅜-in. double fillet weld 15½ in. long. One-inch plates stiffen the column.

The beams are linked to the girders by cross-shaped connecting plates (Fig. 7), 6 by 22 in., each plate having two ears 5½ by 9 in. A ⅜-in. fillet weld is made along the top flanges. The bottom flange of each beam is linked to the girder with a two-pass, ⅜-in. bead in a beveled joint. The beams are welded to the seat angles (4 by 3 by ⅝ in.) by plugs that replace the erection bolts. The plug welding is done along the bottom flange.

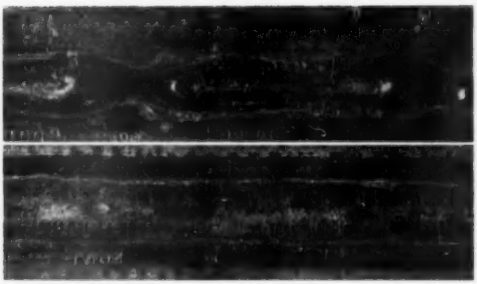
To attain the necessary headroom for the escalator opening on the seventh to ninth floors, an unusual connection was used (Fig. 8). The upper girder, erected first, was connected to the lower girder by a machine bolt (1¾ by 6½ in.) with lock washer and two nuts. The nuts were tightened with hammer and chisel to set the threads. A 6½ by ½ in. rocker plate lies between the girders, which are stiffened by ½-in. plates on either side of the bolts. A 6 by 4 by ⅝ in. angle on the web of the lower girder supports a floor beam; a ¼-in. fillet weld 6 in. long was made along the outer edge, and a ⅜-in. two-pass weld 3 in. long was made along the end and against the stiffener. Atop the beam, a 4 by ¾ in. bar 2 ft long was joined with a ⅜-in. fillet weld.

In the girder to column web connection (Fig. 9), girders are linked with 1-in. and 1⅛-in. plates 4 in. wide. Bottom flange of the girder is welded to the seat plate with a ½-in. double fillet weld on each side for 8½ in., leaving a gap of at least an inch between the web and the extension of the 5 by ⅝ in. angle plate. The top flange is welded to the connecting plate with ½-in. double fillet welds for about 14 in. along the sides and at the end. A ⅝-in. fillet weld holds the connecting plate to the column.

General contract for this building project was held by the Henrik Valle Co.



1–CLOSED-DELTA circuit: upper weld illustrates a reversed phase and lower weld a normal phase sequence



2–OPEN-DELTA circuit: upper weld (¼-in. plate), normal phase sequence; lower, reversed phase sequence

Submerged-Arc Welding in Tandem*

Several of the largest volume users of submerged-arc welding have for some time been operating with three-phase power applied to two welding rods arranged in close tandem with their tips in a common pool.

BY E. A. CLAPP
Union Carbide and Carbon Research Labs.

AND NORMAN G. SCHREINER
Linde Air Products Co.

• The choice of the type of power to be used for welding is usually a compromise between two major factors. In most instances, the use of alternating current satisfactorily eliminates the effect of magnetic fields around the arc, usually known as "arc blow." Such welding current is almost universally supplied by specially designed single-phase transformers, and a considerable unbalance in the usual three-phase plant supply system may occur in a shop where a significant amount of the total power consumption is represented by a welding load.

• Balanced loads can be obtained with motor-driven generators: the motor is operated from the three-phase line and the generators usually provide d-c welding power. This type of power, however, is particularly susceptible to arc blow, the correcton of which may prove to be practically impossible in many instances. A few a-c generators have been installed but have not been particularly successful, chiefly because of lack of flexibility in control of the welding power.

• It is obvious that there is considerable advantage to be gained through the use of three-phase power directly for welding. Proper choice of transformers, corrective capacitance and adjustment of welding load can be made to provide an essentially balanced primary load and yet retain the virtues of an a-c welding source as compared with direct current.

A NEW METHOD we have devised uses three-phase power in submerged-arc welding. Two rods are positioned in tandem over the seam to be welded. Each rod is independently driven by rod-feed motor, control and guide tube. One lead of the three-phase power supply is connected to one rod; the second lead to the other rod, and the third lead to the ground clamp. The two rods used in this method are necessarily closely spaced so that their tips are in a common pool of fused material. Our new technique has been developed to the point where it is being used quite extensively in commercial practice, especially for the manufacture of tubular products on a high-production basis. Welding speeds are two to three times faster than can be obtained with a single-rod technique.

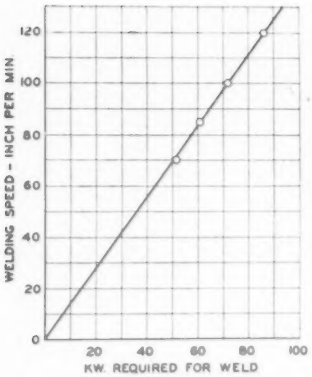
In the initial development of this technique, we investigated the three basic three-phase transformer circuits: open-delta, closed-delta and wye. Though all three circuits could be utilized for welding, the two delta circuits were found to exhibit considerable advantage over the wye circuit. The welding current that can be drawn from a closed-delta system, for example, is 1.73 times the rated capacity of the transformers, whereas only the normal rated capacity can be used in the wye system. As it is current that generates the welding heat, the effectiveness of the delta system is obviously considerably greater. The high voltage produced by the wye system is of no advantage as the excess must be absorbed by appropriate ballast.

Factors such as the possible effect of phase angle, phase sequence, power distribution between rods and the effect of primary power factor also had to be investigated. Most of these factors were found to have considerable influence on the quality of the welds produced. It is these effects (and the control of weld quality that is provided by their proper utilization) that impart to the three-phase tandem technique its unique characteristics.

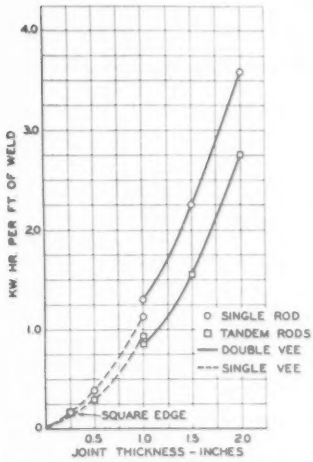
Let's first look at the effects of each of these variables independently and then at their combined influence. Some reference will be made to a d-c system as this will help to clarify the a-c phenomena.

To go back to fundamentals, a flexible or movable conductor can be set

*Abstract of a paper presented at the 32nd annual meeting of the American Welding Society, Oct. 16, 1951.



3—SPEED versus power required (kw) for welds made in ¼-in. plate



4—ENERGY requirements of both single-rod and tandem techniques at different thicknesses and varying methods of edge preparation

in motion by the action of a magnetic field. An arc is a flexible conductor and therefore subject to deflection by a magnetic field. In submerged-arc welding, weld quality and the direction of arc movement or deflection are definitely related. If the arc is deflected rearwardly over the weld puddle, a weld of poor appearance will be produced: forward deflection will result in production of a smooth weld free from undercutting.

The magnetic field that is needed to produce the desired arc deflection can be obtained in several ways: by permanent magnets, electromagnets or a self-induced field. From the standpoint of both control and economy, however, the simplest method is to use the field surrounding a second conductor, which brings us to our two electrodes in tandem.

If the magnetic pattern of such a system is considered, it can be shown that by proper choice of electrode polarities, the fields of the leading rod current and the total ground current could be utilized to deflect the arc at the trailing rod forward—the direction that favors production of a good weld. At the leading rod, the situation was not so good. The fields produced by the trailing rod current and of the ground current of the leading rod tend to neutralize. Thus, the direction of deflection of the leading arc is not subject to such accurate control as that of the trailing arc. However, welds of acceptable quality can be obtained as long as all magnetic conditions are so established and controlled as to deflect the trailing arc in a forward direction. The deflection of the leading arc is relatively unimportant.

The direction of welding with respect to the location on the work of the ground line contact is also an integral part of the magnetic pattern mentioned above. It is usually recommended that welding proceed in a direction away from the ground contact. In general, this practice is advocated when the three-phase connection is used, but, because of the facility with which the ground and the rod currents can be adjusted in the three-phase connection, suitable conditions can be established for welding toward the ground contact.

Phase Angle

The phase angle between the two a-c electrode currents was found to have a direct bearing upon weld quality. The phase angle relationship of these two currents regulates the time periods during which the two electrodes are of similar or dissimilar polarities. (As already pointed out, the polarities of the electrodes are a major factor in determining arc deflections.) In a-c welding, the values of the various induced fields are constantly varying in intensity; therefore the arc deflections will not be constant but will also vary. The relative times of deflection in the forward and rearward directions, particularly of the trailing arc, might be expected to exert considerable influence over the weld quality.

The ground current is also of importance magnetically. In the three-phase system, the ground current can be varied over a wide range, independently of the currents introduced into the welding rods. On the other hand, in the connections used with d-c or the combination of d-c and a-c on tandem arcs, the ground current

Table I. Typical Conditions for Tandem Welds Using Three-Phase Power.

Plate Thickness, in.	*Edge Preparation*					*Leading Electrode,*			*Trailing Electrode,*			*Ground Current*	*Weldg. Speed, ipm*	*Total Rod Deposited, lb/ft of Weld*	*Flux Fused, lb/ft of Weld*
	First Side		*Root Face, in.*	*Second Side,*		*Diam., in.*	*Amp.*	*Volts*	*Diam., in.*	*Amp.*	*Volts*				
	Angle	*Depth, in.*		*Angle*	*Depth, in.*										
¼	Square edge					5/16	940	27	5/16	1,080	35	1,160	83	0.159	0.135
½	60°	5/16	3/16			5/16	1,040	28	5/16	860	31	1,180	43	0.312	0.177
1	35°	7/8	1/8			1/4	1,600	37	1/4	1,680	47	1,740	30.5	0.687	0.620
1	80°	5/16	3/8			1/4	920	32	1/4	860	37	980	30.7	0.707	0.633
				80°	5/16	1/4	1,000	32	1/4	1,160	36	1,140	30.4		
15/16	70°	7/16	5/8			1/4	1,020	30	1/4	1,420	40	1,420	22.4	1.578	0.967
				70°	1/2	1/4	1,360	32	1/4	1,480	40	1,400	23		
2	60°	11/16	5/8			5/16	1,440	33	5/16	1,480	40	1,540	17.5	2.286	1.752
				70°	11/16	5/16	1,740	35	5/16	1,760	41	1,920	17.5		

is not subject to such exact control. By varying the ground current, two factors are brought under control: one, the effect of the induced field due to the ground current, and, two, the polarity time factors of the two electrodes. This is because changing ground current will alter the phase angle relationships of the three currents.

Phase Sequence

Another factor found to be of great importance is phase sequence. With the open-delta circuit (which normally provides rather high ground current), and with a welding direction away from the ground contact on the workpiece, the requirement to produce good-quality welds was a reversed phase sequence, referred to in order to the lead rod, the trail rod and the ground connections.

With the closed-delta circuit (where the ground current is only slightly higher than the rod currents), and with the same welding direction away from the ground contact, a normal phase sequence was necessary to produce satisfactory welds.

The welds of Fig. 1 are typical welds in ¼-in. plate produced with a closed-delta circuit. Upper weld illustrates reversed phase sequence and lower weld illustrates normal phase sequence.

Figure 2 shows comparative welds in ¼-in plate for the open-delta circuit. The upper weld illustrates normal phase sequence and the lower weld reversed phase sequence.

When an inductor was inserted in the ground line of the open-delta system, the ground current was reduced to the level normally employed with the closed-delta system. Unsatisfactory welds resulted unless the phase sequence was changed from reverse to normal. Conversely, removal of the ground line inductor from the closed-delta system, which increases the ground current, produced unsatisfactory welds with the normal sequence.

Power Distribution

The distribution of power between rods was found to be of great importance at high speeds of welding. Under the conditions of testing, best results were obtained when 40 or 50% of the total power input at the weld zone was introduced through the leading rod. It was also found desirable that the leading rod carry less current than the trailing rod and that the ground current be greatest of the three. This was true with all three basic circuits. The total power input to the weld is the sum of the power for each arc. The power input to each arc can be approximated quite closely by multiplying each arc current by its corresponding arc voltage.

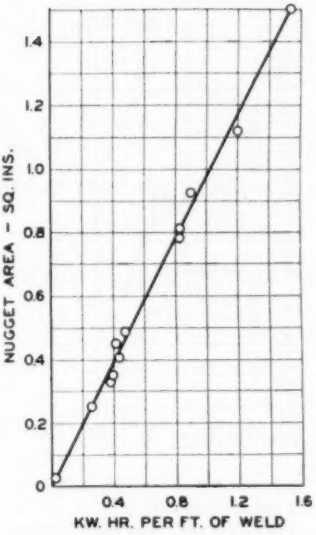
Magnetic environment at the welding zone depends not only upon the welding currents but also upon the proximity of magnetic material in jigs and fixtures. It was reasonable to predict that the weld quality would be affected by the variations in the mass of adjacent magnetic material, and that the above distribution of power might not apply. This prediction was borne out in the practical application of the circuit. The power was divided between the two rods by adjustment of currents and voltages so as to produce the desired weld under the jigging conditions at hand.

Power Factor, Power Utilization

Tests were run without any primary power factor correction and with full correction. Changes in primary power factor had no discernible effect upon weld quality. There was, of course, considerable effect upon primary line and phase currents, and ample corrective capacitance is to be recommended in order to keep the phase currents within the rated values for the primary supply transformers used. Power factor correction can also be used to bring the primary load close to balanced conditions.

The efficiency of power utilization in all submerged-arc welding is improved by increasing the welding speed above the values considered normal for single-rod techniques. Eventually, however, a range is reached in which further increases in speed produce little or no change in efficiency. The speeds attained by the tandem technique, being two to three times greater than single-rod techniques, are apparently within that range. Tests on ¼-in. plate over the speed range of 70 to 120 ipm showed that the relationship existing between speed and actual welding power is essentially straight-line. See Fig. 3.

When welding thin plates, the energy required to make one foot of weld is about the same for both tandem and single-rod techniques. Efficiency of the tandem process rapidly increases as the plate thickness is increased, until, when welding 2-in. plate, the tandem process requires only 75% of the energy required by the older single-rod method. This is shown by Fig. 4.



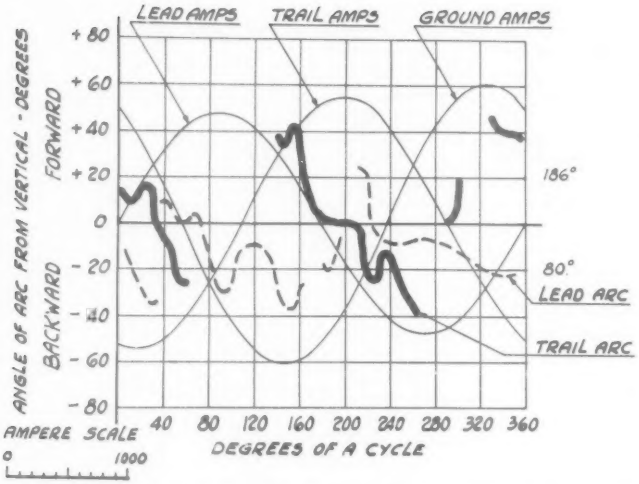
5–STRAIGHT-LINE relationship is shown between energy input and the size of the resulting weld

The ratio between the weld size (or nugget area) and the energy input to the weld was found to be a constant over the range of 14-gage to 2-in. plate with a welding speed range of 190 to 17 ipm. This is shown graphically in Fig. 5.

Theory of Three-Phase

From the above observations, it was deduced that complex magnetic forces were responsible for the variety of results obtained during the tests. An hypothesis was developed which attempted to explain the relationships between weld quality and current magnitudes, phase angles, phase sequence and welding direction (with respect to the ground connection) in terms of the magnetic pattern created at the welding zone. Subsequent experiments (as will be described) showed that the essential details of the theory were correct.

At any given instant, the magnetic relationships resulting from the use of d-c power should be applicable to



6–DEFLECTIONS of lead and trail arcs–delta connections and normal ground current. Lead rod, 920 amp; trail rod 1,040 amp; ground, 1,160 amp

an a-c system. In an a-c system, however, the pattern of the relationships is constantly changing. Since there are intervals when the electrodes will be of the same polarity and others when they will be of opposite polarity, there will exist, alternately, conditions tending to produce good and poor quality welds. The ratio of the times of existence of the two conditions is a function of phase angle between the two electrode currents. Thus, alteration of the phase angle should change the magnetic condition from predominantly "bad" to predominantly "good," or vice versa.

In the d-c system, the ground current is the arithmetical sum of the two electrode currents and is not susceptible to independent control. In the three-phase system, however, this current is the vector sum of the electrode currents and it can be varied independently. The ground current also produces a magnetic field that exerts considerable force upon the arcs. In the three-phase a-c system, this influence is brought under control. Thus regulation of the ground current should simultaneously control the effects of the induced fields of the three currents by changing the intensity of the field associated with the ground current and adjusting the phase angle between the electrode currents. Thus the "time factor" described above.

These deductions lead us to the conclusion that the time period during which the trailing arc is deflected in advance of the completed weld must be longer than the time period of rearward deflection in order to obtain a high-quality weld. If this tentative conclusion is assumed to be correct, the effect of phase sequence might readily be explained. We reasoned that if all factors relating to the time factor were not changed, changing of phase sequence could only alter the sequence of events at the welding zone; in effect, it would rotate the arc deflection pattern around a vertical axis located between the two electrodes. Thus the same conditions producing predominantly forward arc deflection with a given phase sequence would produce a predominantly rearward deflection when the phase sequence was reversed, with corresponding change in weld quality.

Reversing Direction of Welding

In considering the effect obtained when the direction of welding with respect to the ground contact point is changed, the explanation of the action in the d-c system might be expected to apply at any given instant. However, this concept must be modified. The ground current of the arc farthest from the ground contact point is in phase with the arc current, but the ground current at the arc nearest ground, being the vector sum of the two arc currents, *is not in phase* with the second arc current. Therefore the ground current does not influence the two arcs to the same degree nor at the same time.

Reversing the direction of welding, therefore, does not merely reverse the pattern of arc deflection at the two electrodes, but, in addition, probably alters the time factor of arc deflection! If the d-c explanation applied directly, it would be expected that the effect obtained by reversing welding direction could be compensated by a reversal of phase sequence. Yet, if the second explanation is correct, this should not be effective, and it might rather be expected that the magnitude of the ground current should be altered, thus changing both the strength of its induced field and the time factor controlled by the phase angle between the two electrode currents.

In combining the above considerations, it became obvious that although the angle of deflection of the trailing arc vs. time would be the resultant of the four essentially sine-wave functions and therefore follow a general sine pattern, in effect, the zero axis of the deflection curve would be shifted from the normal position. Therefore the time factor would not be predictable as a function of phase angles and sequences alone. Because of the practical difficulty either of measuring intensity and direction of the magnetic fields or of calculating these quantities (the current path and distribution within the workpiece is not readily determinable), the relationship between optimum ground current magnitude and welding direction could not be predicted.

Experimental Corroboration

Although the above theory was based, to a limited extent, upon observed phenomena, most of it was developed without benefit of supporting evidence. It was desirable that such evidence be obtained, if possible, because successful commercial application of the technique would require a dependable working theory for guidance of service personnel.

Welds could be and were made under a variety of conditions to show the effects on weld quality, but these could not display the mechanism by which the results were produced. In

order to study the arc action directly (the arc normally being completely blanketed from view by the granular welding flux composition), test welds were made under a partial atmosphere of argon to prevent oxidation effects. These welds were made at current and voltage values equal to those used with the submerged-melt composition, and the arc photographed with a hyperslow motion technique.

Film speeds were chosen to provide approximately 6,000 frames per second—100 frames per cycle. Two exposures were made on each plate welded: one at the midpoint and the second near the finish end of the weld. Examination of the films, one frame at a time, provided data on the deflection angle (from the vertical) of the arc vs. time. Plots of these angles (Fig. 6) disclosed the time factors discussed above, the direction of sweep of the arcs and an indication of arc stability. The curves did not cover the full cycle of 360 electrical degrees, there being gaps where the arc was extinguished (near the zero current axis) or where the photographic image was too dim and indistinct to measure. These graphs indicated the variation in the arc deflections due to changes in the ground current only.

In Fig. 6, phase rotation is normal; the trail current lags the lead current by 107° 30′; ground current lags the lead current by 239° and welding is done away from the ground. The ampere scale (lower left corner) refers to the amplitude of the current sine waves.

Welds were then made under the customary blanket of flux, using the same variety of conditions, in order to correlate weld quality with the arc action observed in the photographs. Examination of the data showed that the theory given above was correct. Other tests have shown that the second explanation of the relationship of ground current to welding direction was the correct one.

Commercial Applications

The tandem welding procedure has been most widely used commercially in the production of high-pressure, large-diameter gas and oil transmission pipe. Welding speeds obtained are as great as 100 ipm on ¼ to ⅜ in. material. This compares with 25 to 35 ipm where single-rod machine welding is practiced. In Table I, typical conditions are recorded for single-pass tandem welds from ¼ in. to 1-in. plate and for double-vee welds up to 2 in. in thickness.

The tandem procedure can be used to weld both longitudinal and girth joints of pressure vessels of diameters greater than about 54 in. It is particularly to be recommended where large numbers of vessels of essentially the same design are fabricated on a production-line schedule. In this sort of operation, the large increase in welding speed developed by the a-c tandem procedure results in greatly increased output.

The procedure can also be applied to multipass welds. The advantage here is that the rate of metal deposit is greatly increased, even though conditions are established so that the thickness of individual layers does not exceed a nominal ¼ to ⅜ in. Speeds of 30 to 50 ipm per pass have been established without encountering difficulties from cracking or poor bead shapes. This compares to 10 to 18 ipm with single-rod welding.

The weld nugget differs very little from those of single-rod welds. Either welds of deep penetration or wide, shallow welds can be obtained with equal facility.

The distribution of heat differs from that obtained in single-rod welding, as would be expected. In a number of cases, steels or types of joints ordinarily difficult to weld have been welded by this procedure without experiencing the cracking or porosity that even the best techniques applicable to single-rod machine welding could not eliminate.

In summary, then, a novel procedure has been developed and applied to commercial fabrication, which:

1. Directly utilizes three-phase power for welding purposes, in a circuit which can be designed to provide a high power factor and balanced phase loads.

2. Provides great flexibility in the control of weld quality.

3. Because of this flexibility makes possible unusually high welding speeds compared to those normally obtained with the submerged-arc method.

4. Results in considerable improvement in energy utilization.

5. Provides a maximum control over magnetic effects (arc blow), which can be very troublesome under certain conditions of operation.

BIG VALVE AT HOOVER DAM

(Continued from page 39)

Class 1. The dished head was 1-in. plate of the same material. The stiffeners were 6½ in. by 6½ in., 19.8-lb tees. Edges of all junctions of the major plate were prepared for a 60-deg single-vee butt weld having a closed root.

The stiffeners were welded to the head in the shop before shipment. There are eight of them, placed radially like the spokes of a wheel. The remaining stiffeners were welded in place in the field (Fig. 2). They were spaced on 25-in. centers and were held in place by ⅜-in. double fillet welds.

Field Welding Details

All of the field welding was done on the generator floor of the powerhouse. Insofar as possible, the liner was positioned so that most welding could be done in the flat position.

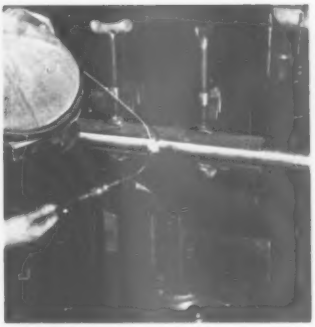
The shell of the liner (which became the vertical portion after installation) was made up of three courses, two plates to a course. This meant three circumferential seams to be welded in addition to two horizontal (vertical after installation) seams running the full length of the shell.

The ¾-in. plates were joined in a five-pass sequence, using ¼-in. E-6010 electrodes. After all the plates had been welded, the job became one of installing the many stiffening rings. The final welding job on the generator floor was that of welding reinforcing rods to the stiffening rings. These were to allow the liner to be concreted in place after it was lowered into the wheel pit.

After the vertical section was welded, the unit was placed in the upright position in which it would subsequently be installed for the discharge section to be welded in place. This horseshoe-shaped piece measures 12½ ft high by 12½ ft wide. As may be seen from Fig. 2, the liner has assumed the appearance of a giant T, with a plug closing one of its ends. It is now ready to be lowered into the wheel pit to be concreted into place (see sequence pictures at top of page 38 and the opposite page).

In all, 2,900 lb of electrodes were required for this major welding job.

PIPE CUTTER forms a bevel automatically when it cuts the tubing



ALIGNMENT fixture holds tubing in proper place for tack welding

AFTER TACKING, a uniform bead is torch welded around the tubing

"Permanent" Pipe Lines

Although "permanent" welded piping is as yet in the experimental stage for problems of conveying liquid foods such as milk, it appears it may be the right answer.

BY H. L. BINDEMAN AND L. N. HOOPES
Lucerne Milk Plant, Oakland, Calif.

IT'S LONG been a practice to use pipe lines to convey liquid foods from one process to the next. With the advent of stainless steels and improved methods of fabrication, the durability of such lines has greatly increased until, with proper care and maintenance, their service life is almost unlimited.

Pipe lines are particularly important to the dairy industry, which has always had to process relatively large quantities of fluid products. The common practice at present is to dismantle lines each day, clean and brush pipe lengths, sterilize them by steam and reassemble the whole system. An all-welded pipe line, obviously, cannot be dismantled for cleaning purposes so other provisions must be made. Cleaning and sterilizing of permanent lines is best accomplished by the use of circulating pumps in conjunction with solution tanks.

SOLDERING VS. WELDING

Present practice of connection is to join pipe lengths with sanitary unions, which are either soldered or expanded to the ends of each length of pipe. Outlets, valves or bends may be either soldered to the pipe or connected to it with sanitary unions.

There are two common faults of soldered or expanded connections on stainless lines, affecting both sanitation and durability of the line.

First, it has been necessary for strength to fit all sanitary connections to pipe by sleeved or recessed fittings. As this involves overlapping of two layers of metal, the possibility of a void between these layers always exists. This condition is true in soldered connections due to dissimilarity in characteristics of solder and stainless steels. Voids between the pipe and fitting are always potential sources of bacterial contamination.

Secondly, the repeated handling, washing and assembling of lines has always been a source of mechanical damage. The frequent handling has in many cases caused broken connections, battered fittings and bent or badly dented lengths of tubing. Hence continual replacement and repair are necessary on this type of line. The examination of lines being replaced has showed voids in many fitting connections that appeared to be in good condition before they were removed.

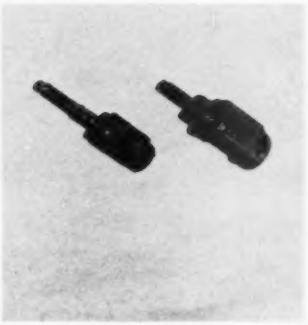
After considering the faults of the removable pipe line, food engineers believed that some improved method of fabrication should be attempted. Since the welding of stainless tanks and containers has become routine, it was only reasonable to assume that sanitary pipe lines could also be welded. A great amount of experimental work was done on the fabrication of fittings, including welding and the grinding of welds, before a workable permanent pipe line came into being. Once the first successful permanent welded line had been assembled, it became apparent that a certain logical routine must be followed in the planning and installation of such lines.

PLANNING THE PIPE LINE

As an all-welded permanent line is expensive and difficult to change once put in place, careful planning of the layout is needed. Consider first the products to be run through the line and the sequence in which they will be run. Bear in mind that the line cannot be disassembled for cleaning.

Sometimes it may be necessary to rearrange the schedule of processing certain products which are all to be run through the same line. Provision should be made for connections to the line from the various vats or tanks used for finished or unfinished products. Pipe lines must be so arranged that they may easily be cleaned by circulation of cleaning

INTERNAL GRINDER developed for finishing the interior welds



SPRINGS in grinding heads hold abrasive sticks against pipe wall

INSERTING the grinding head in a pipe to do the inside grinding

for Liquid Food Products

solutions. This makes a compact system necessary to eliminate long, cumbersome return lines.

It is important that sufficient outlets and inlets to the line be provided for processing or storage equipment. By judicious use of three-way valves, it is often possible to run products in either direction in the line from any piece of equipment. This is often necessary when one product is placed in two or more tanks that are supplied by a single pipe line.

All turns must be made by crosses, which give access in either direction and make it possible to grind all welds. Crosses also make inspection of the interior of the lines possible. Short, removable pipes for connecting equipment to the pipe line are desirable, as this scheme makes it possible to clean any piece of equipment while the pipe line is in use conveying other products. Finally, the pitch of the lines should be thoroughly considered in order to insure adequate drainage.

To summarize the above paragraph, when the pipe line is completed, it should meet the following requirements: (1) It should be practical. (2) It should be compact. (3) It should handle all necessary products in proper sequence. (4) Return lines for circulation should be short. (5) Any part of the processing equipment should be removable from the system for cleaning or repair without impairing efficiency of the pipe line. (6) Allowance should be made for inspection of the line and for access to all welds made during the fabrication. (7) The line should be so planned that new equipment or expanded processing can be added without redesigning the whole system.

Preparing and Welding Pipe

Joints that can be butt welded are first prepared by cutting both pieces to be joined with a pipe cutter, using a reasonable amount of pressure. This will slightly flange each piece, and the flanges when placed together form a vee, which holds and acts as a guide for the weld metal.

Pieces to be joined are first fluxed on the inside, then placed in a clamp and spaced about 1/32 to 3/64 in. apart. When properly spaced and aligned, the joint is tack welded in at least eight different places. Tacks should be placed opposite each other, and care must be taken to tack on the opposite side after each tack is made. This tacking procedure is very important as it eliminates much of the heat distortion that occurs when thin-wall stainless steel tubing is welded.

After tacking, a uniform bead is applied all around the joint. Sufficient heat should be used to insure proper penetration of the welding material. The amount of heat and penetration of weld can best be determined by making trial welds on short lengths of tubing, which are then split and examined.

For gas welding, use pressures of 7-10 psi of acetylene and 5 psi of oxygen with a No. 1 or No. 0 tip and a 1/16-in. stainless-steel welding rod. The flame is adjusted to a slight feather. The minimum amount of heat necessary for penetration will give best results. Arc welding is faster, but only a skilled operator can obtain the uniform results that are needed in this type of work.

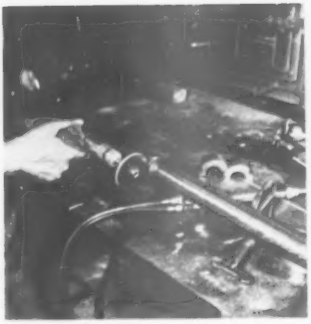
Grinding, Polishing Inside

It is necessary to grind the inside of the joint after each weld is completed. Grinding and polishing of the outside can be deferred, if desired, until after the job is completed as a whole.

For inside grinding, a small circular grinding head is used. This is spring-loaded and designed to hold three small sticks or hones made of aluminum-oxide abrasive. A different size of grinding head is necessary for each diameter of tubing. A common size is 1½-in. tubing. Whatever the size of tubing, it is necessary to obtain a flexible shaft that will fit into it and drive the grinder head. A dairy pipe cleaner flexible shaft is satisfactory for the purpose.

After a great number of experiments, we found that resinoid-bonded sticks of 120-grit aluminum oxide would do a fast, clean job of grinding in a grinding head turning at 4,500 rpm. Complete removal of all excess metal can be accomplished in

FLEXIBLE-SHAFT grinder can go as far as 20 ft inside the tubing



SMALL WHEEL will grind off the high spots of external weld bead

BUFFING wheel removes evidence of welding and heat discoloration

two or three minutes. By adding additional lengths of flexible shaft, joints between two 20-ft lengths of tubing can be successfully ground.

The length of time needed to grind the inside of the weld is determined by inspection of the joint wherever possible. Another way is to remove and inspect at regular intervals during assembly the welds that will be in the center of long runs of pipe. Careful timing of grinding is necessary as there is a greater danger in overgrinding than in undergrinding. Final inside polishing can be done with rubber-bonded aluminum-oxide abrasive sticks.

Care should be taken during all grinding operations to keep the work cooled. One way is to wrap a wet cloth around the outside of the joint; another way is to run cold water on the joint. Cooling not only prevents discoloration of the work but greatly prolongs the life of the abrasive sticks. It should be mentioned here that the flanges formed by the pipe cutter, by confining the weld, eliminate much grinding that would otherwise be necessary.

Outside Grinding

For grinding and polishing the outside of the welds, 6-in. sewed buffing wheels are used. These are coated with adhesive, then sprinkled with 120-grit "alundum" powder. After drying, they are ready for use on a flexible shaft or a portable grinder. This method does not give a high polish to the surface, but it will remove most of the scale and discoloration and give a satin appearance to the tubing. A high polish can be obtained by first lightly grinding the outside of the weld with a 30-grit rubber-bonded grinding wheel, following this with a cloth wheel using 120-grit "alundum" powder and finishing with a soft buffing wheel and polishing compound.

Hangers or supports are needed for all pipe-line assemblies. They should be mounted rigidly and close enough together to prevent vibration and strain on any section of the line. Careful planning and placing of supports for the line will prevent later mechanical damage or failure.

Cleaning and Sterilizing

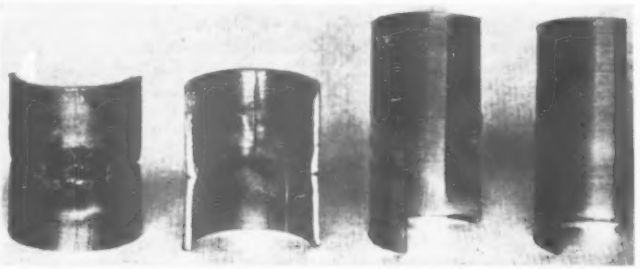
For cleaning and sterilizing of permanent lines, a method similar to the procedure now used on plate and tubular heat exchangers is giving desired results. Briefly, this consists of a rinse with warm water, circulation for 20 or 30 minutes with a hot (140 to 150 F) inhibited acid solution, water rinse, circulation of hot alkali cleaning solution, water rinse and final circulation with a chemical sterilizing agent such as a chlorine solution for one to two minutes.

Solution tanks permit the recovery and re-use of a large portion of the solutions. They also permit uniform mixing of cleaning compounds in definite volumes of water.

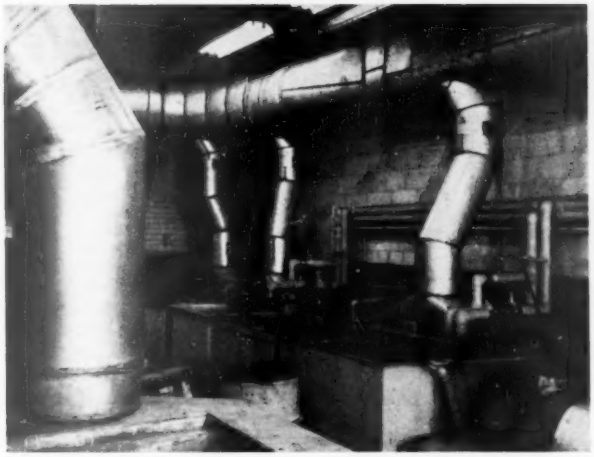
All removable parts of the pipe line assembly are removed, cleaned and replaced before the sterilizing solution is circulated. These parts must all be carefully flushed with the sterilizing solution during circulation.

Effective cleaning by the circulation method is dependent on the velocity of the cleaning solutions. It has been found that small pumps placed in series at intervals of 100 ft imparted a greater velocity to the solution than could be obtained when one large pump was used.

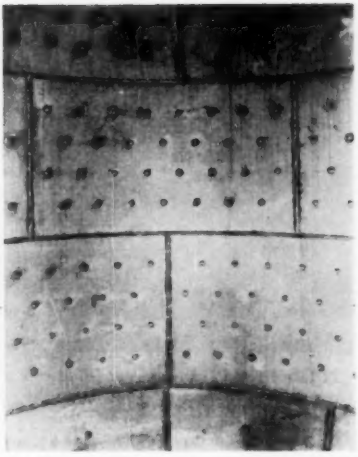
In conclusion, welded pipe lines should cut maintenance and repair work to a minimum. Without the newer types of compounded acid and alkali cleaners, however, the difficulty of cleaning would have precluded this newer method of line assembly. Limited quality tests indicate that bacterial contamination has been reduced as compared with the old method of cleaning removable lines.



HOW TACK-WELDED tubing looks outside and inside is shown by specimens at left. Right sections are joints after internal grinding of welds



DUCTS LEADING corrosive fumes from electroplating tanks were of 316 ELC stainless steel to avoid intergranular corrosion at welds



WELD DECAY won't occur in this ELC stainless liner for a processing vessel

Corrosion-Free Stainless Welds

Obtaining their resistance to intergranular corrosion by an exceptionally low carbon content, the ELC stainless steels substitute for columbium-stabilized.

BY G. E. LINNERT
Research Welding Metallurgist, Armco Steel Corp., Middletown, O.

COLUMBIUM-stabilized stainless steels are a war casualty, but the extra-low-carbon chrome-nickel stainless steels are alternates for the stabilized grades where service temperatures are below 800 F. Obtaining their resistance to intergranular corrosion by an exceptionally low carbon content (max 0.03%), they conserve vital columbium. They also make possible field repair and erection without the use of stabilized stainless steels, eliminate the necessity of annealing stainless weldments and reduce metal and fabricating costs.

INTERGRANULAR CORROSION

Despite the excellent general corrosion resistance of chromium-nickel stainless steels of the regular 18-8 types, serious corrosion can occur if they are subjected to severely corrosive conditions after being exposed to temperatures in the "sensitization range" of 900-1,600 F. This type of corrosion is intergranular and is due to a change in the metal that occurs in that temperature range. Chromium near the boundaries of the metal grains unites with carbon to form chromium carbides. This depletes these areas of chromium, thereby reducing their corrosion resistance. When intergranular corrosion occurs near a weld joint, the attack is sometimes called weld decay.

Three methods of eliminating intergranular corrosion have been developed. They are: (1) annealing after welding; (2) using stabilized stainless steels containing columbium, tantalum or titanium; and (3) using extra-low-carbon stainless steels.

Annealing at temperatures of 1,900-2,000 F after welding redissolves precipitated chromium carbides and thus puts the chromium back into the depleted grain boundary areas. This procedure is satisfactory for many stainless weldments but is impractical for large structures or in field repair or erection.

Special alloying elements are added to stainless steel to prevent the precipitation of chromium carbide. Columbium, tantalum and titanium form carbides much more readily than chromium and hence tie up the available carbon. These stabilizers, therefore, let chromium exert its full corrosion-resisting effect.

Stabilized stainless steels can be welded or used in the temperature range of 900-1,600 F without being subject to harmful carbide precipitation. Before the development of the extra-low-carbon chromium-nickel stainless steels, weldments that could not be annealed had to be made of stabilized grades. Likewise field repair or construction of stainless equipment by welding required the use of stabilized types.

ELIMINATE ANNEALING

The extra-low-carbon grades were developed as alternates for the stabilized grades before defense restriction limited columbium. They may be used where service temperatures are under 800 F. They cost less than stabilized grades and eliminate the expensive annealing or heat treating of standard grades. This is because harmful carbide precipitation due to welding or other short-time exposure in the sensitization range is eliminated in the extra-low-carbon stainless steels by reducing the carbon content to a very low level. They have a maximum carbon content of only

PULP digesters in a paper mill represent another ELC application

Table I. Mechanical Properties at Elevated Temperatures

(Short-time high temperature tests)

Grade	*Test Temperature*	*Ult. Max. Strength, psi*	*Yld. Strength (0.2%), psi*	*Elong., % in 2 in.*	*Red. of Area, %*
Type 304	Room	85,000	38,000	60	70
	400	70,000	20,000	55	69
	800	68,000	16,000	45	68
Type 304 ELC	Room	80,000	34,000	60	77
	400	60,000	17,000	52	75
	800	57,000	13,500	48	68
Type 316	Room	80,000	38,000	55	77
	400	78,000	29,000	50	75
	800	74,000	22,500	38	68
Type 316 ELC	Room	77,000	34,000	60	70
	400	63,000	18,500	51	62
	800	59,000	15,000	47	56

0.03%. This is not enough carbon to tie up much chromium. The ELC grades can be used in the as-welded condition or stress-relieved without becoming susceptible to intergranular corrosion. However, they must not be used at temperatures much above 800 F.

Weld Joint Corrosion

The severity of weld joint corrosion in austenitic stainless steels depends on the time and temperature of exposure to the precipitating range of 900-1,600 F as well as on the carbon content. If corrosive conditions are not severe, depletion of chromium through carbide precipitation due to welding may not be detrimental and standard non-stabilized grades are satisfactory, particularly in the lighter gages (16 gage and under). Examples of such applications are welded food processing and dairy equipment.

In standard non-stabilized grades, weld joint corrosion or weld decay is most frequently encountered in severely corrosive conditions. Processing vessels and pipe lines in paper and pulp, textile and chemical plants are typical of applications where severe corrosion is experienced. In such applications, type 316 stainless steel is widely used for its greater corrosion resistance. But to retain the full potential corrosion resistance, precaution against weld decay is essential.

The extra-low-carbon stainless grades, type 304 ELC and 316 ELC prevent such intergranular corrosion. For this reason, they have found wide application in the chemical, pulp and paper, textile and petroleum industries. Because intergranular corrosion becomes more important with increasing severity of service conditions, demand has been more for the molybdenum-bearing type 316 ELC, which has greater overall corrosion resistance than the 18-8 low-carbon grade. However, there are many places where stabilized grades have been used in place of type 304 in order to prevent weld decay. These applications have included commercial air-conditioning equipment, smoke stacks and duct work in chemical plants, welded tubing, hoods and exhaust ducts in textile plants, and drawn shapes for welded assemblies. All these products are now being made of type 304 ELC.

Properties of ELC Steels

The extra-low-carbon grades are identical chemically to their standard counterparts with the exception of carbon content. Whereas type 304 and 316 contain 0.08 maximum and 0.10% maximum carbon respectively, the ELC grades contain a maximum of only 0.03% carbon.

The extremely low carbon content of the ELC stainless steels naturally has some effect on their strength, hardness and ductility, but these differences are small. In many cases the low-carbon grades can replace the stabilized grades without any design changes. However, slight allowances in design values may be necessary in the case of pressure vessels, pressure piping and other highly stressed products.

The Boiler Code Committee of the American Society of Mechanical Engineers recently issued a special ruling on the use of the extra-low-carbon grades of austenitic stainless steels under applicable code rules. This ruling (Case No. 1122) permits the use of types 304 and 316 containing 0.03% maximum carbon in unfired pressure vessels. Requirements for mechanical properties and maximum allowable working stresses are established.

In addition to good mechanical properties at room temperature, the ELC grades retain their strength at elevated temperatures. Typical mechanical properties at 400 to 800 F (the latter is the maximum allowable service temperature) are shown in Table I.

Since the chromium and nickel contents of the extra-low-carbon stainless steels are the same as the standard types, their general corrosion resistance is also the same. It is also equal to or slightly better than that of the stabilized grades.

Annealing of the low-carbon stainless steels will not adversely affect their corrosion resistance since annealing temperatures are above the carbide precipitation range of 900-1,600 F. Stress relieving at 1,600 F for two hours also has no harmful effect. Only a small number of carbides, not enough to be harmful, appear after such heat treatment.

Precautions must be taken, however, to eliminate the possibility of carburizing during any type of heat treatment. Weldments should be cleaned of oil, grease and other carbonaceous materials before heat treating. While at temperature, the weldment should not be in contact with a carbon-steel jig or supports.

Table II. Recommended Electrodes and Filler Rods

Grade	Electrode or Filler Rod Type No.
Type 304 ELC	308 ELC 347
Type 316 ELC	316 ELC 310 Mo 316 Cb

Table III. Tensile Properties of Weld-Metal Specimens*

Weld Metal Type No.	Ult. Strength, psi	Yield Strength (0.2%), psi	Elongation, % in 2 in.
308	80-95,000	50-60,000	35-45
308 ELC	75-85,000	45-55,000	35-45
316	85-95,000	55-65,000	30-45
316 ELC	75-90,000	45-55,000	30-45
310 Mo	80-95,000	50-60,000	30-40
347	85-95,000	55-65,000	30-40

*Specimens machined from arc-welded material. Tested in as-welded condition in accordance with ASME Spec. SA-298.

Needless to say, perhaps, the furnace atmosphere must not, under any circumstances, be carburizing.

Types 304 ELC and 316 ELC have the same general weldability as their standard counterparts. Identical techniques are used for jigging, control of distortion, rod and torch manipulation and methods of joint design. Practically all welding methods for the regular chromium-nickel stainless steels can be used to weld the ELC steels: oxyacetylene, metal-arc, inert-arc, atomic-hydrogen and resistance-welding processes.

As in heat treating, special care must be taken to insure that both filler rod and welding surfaces are free of oil, grease, dirt and other carbon-containing material. To permit carbon to come in contact with the weld metal will defeat the purpose of using extra-low-carbon stainless.

The reducing flame that is ordinarily used in oxyacetylene welding may cause carbon pick-up; the filler rod, therefore, should be of columbium-stabilized stainless steel. With either an ELC rod or no filler rod at all, the oxyacetylene weld may be subject to carbide precipitation.

Other flame operations such as cutting and scarfing present no problems with the ELC grades. Procedures recommended for the regular chromium-nickel stainless steels work equally well on the low-carbon grades.

When arc welding ELC stainless, the selection of the proper electrode is of paramount importance. Carbon pick-up must be avoided, and (in the case of type 316 ELC) proper corrosion resistance must be obtained in the weld.

In general, the extra-low-carbon grades are welded with an electrode of similar composition or with an electrode containing columbium. This gives either low carbon or stabilized weld metal, both of which will resist intergranular corrosion. It is not now permissible (except on certain defense orders) to use welding rods containing columbium. Titanium-stabilized electrodes are not regularly manufactured because the titanium is almost completely lost during deposition. Weld metals that give the best results are listed in Table II.

Where welds in type 316 ELC are to be used in the as-welded condition and exposed to severely corrosive media (such as hot oxidizing acids), type 310 Mo filler rods should be used. This weld metal will have good corrosion resistance under such conditions. If weldments are stress-relieved at 1,600 F for two hours, or if service conditions are not severe, either ELC or columbium-containing electrodes will be satisfactory for welding type 316 ELC.

While they can be used satisfactorily, columbium-stabilized electrodes are not necessary to arc weld the extra-low-carbon stainless steels.

Properties of Welded Joints

Properly made welded joints in extra-low-carbon stainless are sound, ductile and have high strength. Properties of the weld metal differ slightly from those of the base metal. This is due to the dissimilarity in structure and chemical composition between the deposited (cast) material and the wrought base metal.

The weld metal has a slightly higher tensile and yield strength and somewhat lower ductility and impact strength. Table III compares typical tensile properties of regular weld metals with those of extra-low-carbon weld metals. Properties were determined on standard test specimens machined from all-weld metal deposited by arc welding and tested in the as-welded condition.

While service experience is proof of the weldability of the ELC stainless steels, it is even better proof of the corrosion resistance of weld areas. Use of ELC steels in pulp digesters, piping, acid tanks and processing vessels has demonstrated that the corrosion resistance of the ELC types is as good in the weld areas as in the unaffected base metal. Neither welding nor stress-relieving heat treatments have resulted in intergranular corrosion of welded ELC chromium-nickel stainless-steel structures.

To test the corrosion resistance of the extra-low-carbon stainless grades, arc-welded sample plates ½ in. thick were subjected to a nitric-hydrofluoric acid etch test. Each specimen was immersed in a 10% nitric—3% hydrofluoric acid solution at 175 F for three 4-hour periods. In austenitic stainless steels, this test produces vigorous intergranular attack, even on areas where carbide precipitation has been slight. With the type 304 ELC and 316 ELC specimens, no evidence of intergranular corrosion was found in either the as-welded or the stress-relieved condition. Comparison of the etch-test results on the ELC specimens with those on type 347 stainless indicates that the ELC performance is equal to that of columbium-stabilized grades. Similar tests on ⅛-in. thick material show the same relative results.

Both laboratory and service experience indicate that the general corrosion resistance of the extra-low-carbon grades is as good as but not better than their standard counterparts. However, the elimination of harmful carbide precipitation makes the ELC steels resistant to intergranular corrosion so that they can be used in welded structures without annealing.

The extra-low-carbon stainless steels are thus performing a vital task. They eliminate costly postweld annealing, simplify field repair and reduce metal costs. Most important today, they conserve a strategic element, columbium.

TRAINING at the mechanical engineering department, University of Washington, places emphasis upon fundamentals. Above is the comprehensive welding laboratory. Close-ups of its equipment appear on the right

What Should Be Taught in Metal-Arc

What the welding industry needs is a program for qualification that will unshackle the weldor and encourage him as a man free from restrictions.

BY GILBERT S. SCHALLER
Professor of Mechanical Engineering, University of Washington, Seattle

TRAINING patterns for skilled and competent men in every phase of metalworking become of increased importance with the advent of an emergency. It is not true, as many people believe, that the increased use of automatic machinery cuts down the need for skilled men. So far that particular situation, logical as it may seem, has never developed.

The training problem was not serious in the early years of the century inasmuch as we depended upon immigration for many of our skilled people. With the legislation of restricted immigration, American industry needed to turn in new directions to supply its artisans. This has not been an easy transition inasmuch as many of our educational programs, especially at the high school and college levels, have done little to encourage students in the direction of trade training. It is reassuring to note that some high schools are encouraging diversified occupational courses together with vocational instruction. School authorities in the larger cities, especially those prominent in metal manufacturing, are taking cognizance of the opportunities open to trained personnel in the skilled occupations in the metal manufacturing field. While all of these programs are commendable, some of them are not producing the maximum potential.

Welding, and particularly arc welding, is a late comer in a field that has prided itself on its artisanship since its inception. There has not been sufficient time to develop a program, and least of all a tradition, to be followed in the training of weldors. Hence little unanimity will be found in weldor training programs as they are conducted in industry and in vocational schools.

Many companies feel that they can best train their own weldors under their own conditions. This practical viewpoint is apt to result in weldors being trained to do just one particular job. The situation is further complicated by the contention that little time need be devoted to training a weldor since the equipment he uses is of such a nature that little skill is required in its application and manipulation. Claims are continually being pressed in an attempt to buttress this contention. Should this thesis continue to develop, it is conceivable that weldor training will decrease to the point of impotency.

It is important to distinguish between a production weldor and one who is employed on jobbing and repair work. The production weldor frequently devotes himself to repetitive operations or occupies himself exclusively with automatic equipment. Also, it is necessary to understand the demands on the weldor. In some companies, operations are completely engineered, while in others discretion is permitted to the men doing the actual welding.

Standard procedures are not as common in metal-arc welding as they are in resistance welding since much arc welding is still regarded as an art rather than a science or, perhaps, more accurately, as a combination of both. To put it in another way, the

FLAME-CUTTING equipment is of a late-design automatic type

MONITOR connects to welding circuit and will measure arc lengths

GROUND plate prevents spatter build-up in submerged-arc welding

Weldor Training

individual equation enters to a greater extent in metal-arc welding than it does, say, in automatic spot welding.

A noteworthy trend is the increased use of codes and standards such as those developed by the AWS Technical Activities Committee and published by its parent organization, the American Welding Society. Increasing use of codes and standards can be seen in the building codes of larger cities. Similar situations are found in pressure vessels and other equipment where fabrication is considered critical from the standpoint of end use. It would seem reasonable to state that the welding apprentice should be indoctrinated in the existence of codes and specifications and especially their objectives. It has been claimed that arc welding is being hampered by the increasing number of codes that surround its use. There may be something to be said for this, but it can be offered in rebuttal that codes are developed to insure correct design and use of welding. When there can be no question about the validity of welding, there will, undoubtedly, be a relaxation in code writing.

The trainee who is ambitious to develop his talents beyond the specialist in production welding is confronted with a broad array of requirements. If, however, he masters such training, he can qualify as a skilled artisan, and one who will be of significant value to his employer. I do not propose, here, to detail a rigid program of training, but I should like to call attention to some of the basic knowledge that an accomplished weldor should possess. The starting point for such a program is not easy to find.

Those Qualification Tests

The significance of welding can be presented by introducing the trainee to the subject of codes and specifications. In some of these, he will gain an appreciation of the qualifications that will be expected from him. He will be introduced to the subject of qualification tests, which, after all, are the determinant of a skilled weldor. Too frequently, weldor qualification is overlooked or by-passed in favor of electrode manipulation. The trainee develops efficiency in manipulation, but his training has not been sufficiently basic to enable him to pass qualification tests successfully. This situation has occurred many times, and for that reason is discussed here.

The ultimate objective of any training program should be to develop abilities that will produce a certified weldor. In achieving this objective, much more than manual dexterity is involved. Regretably, many trade schools have overlooked this very fundamental issue with the result that the men they have trained find it extremely difficult to carry on in industry.

Weldor training can be more objective when code writers understand that welding is an accepted method of joining metal in all designs. There are too many divergent ideas and conflicting opinions expressed by the different codes. Weldor qualification, or certification as it is sometimes named, is an outstanding example.

There is no counterpart elsewhere in the metalworking industries to the perplexing weldor qualification as set forth in welding codes as they are now practiced. A machinist does not need to pass a qualifying test every time he transfers from one machine tool to another. A molder need not mold and pour a test casting whenever he changes patterns. The weldor, however, is confronted with the nec-

GUIDED-BEND equipment makes tests on students' weld specimens

essity of continually requalifying for each different job and/or material. Why is it necessary for him to continually submit himself to this time-consuming, wasteful and nerve-racking experience? Those without the industry can hardly fail to be suspicious of a joining method that surrounds its mechanics with qualification tests on every hand.

The welding industry and its proponents can best serve themselves and society by recognizing the progress welding is making and instituting a program that will unshackle the weldor and encourage him as a man free from restrictions. If qualification is of the fundamental importance some codes indicate it to be, then let an inclusive code be published that will make it possible for a weldor to be certified for every demand within his area. Such a procedure would automatically supply the motive and inspiration for a weldor to develop his best abilities. He would then have the same standing as his colleagues in other metalworking divisions. His pride in profession would be a powerful stimulant and a continuing inspiration to him. Obviously welding will gain in stature, and the waste in time, material, men and money accompanying endless qualification tests will be stopped.

A complete understanding of the factors that enter into the making of a sound weld requires a broad knowledge of the physical sciences. Such a requirement lies outside the scope of weldor training, yet some of the areas should be explored. Inasmuch as the majority of engineering structures and machines in which the joining is accomplished by welding are made from steel of some type, it would seem logical that the trainee be given a sound background on this material.

Lots to Learn about Steel

When it is realized that the term "steel" is not a generality, some of the difficulties encountered by weldors will be solved. It is necessary to emphasize that there are a great many different types of steel, each of which has its individual composition and its own physical as well as mechanical properties. In consequence, it is incorrect to deal with steel as a specific material; the proper procedure is to consider the different classes of steels. These different materials have different behaviors under thermal treatment, affecting their "weldability."

An added difficulty that is appearing increasingly arises from the dilution of carbon steels due to residual elements in the scrap used in the steel-making charge. This trend was noted and commented on more than 30 years ago by Dr. Richard R. Moldenke. With the program of continually recycling steel, the residual elements will increase and thereby cause changes in properties of normal carbon steels. Obviously, the weldor trainee cannot be a metallurgist of sufficient accomplishment to recognize all of these difficulties. It remains the province of supervision and management to develop welding procedures that will cope with these situations.

Another important property of steel is that of thermal expansion. This is complicated by the necessity for realizing the three-dimensional pattern that expansion will follow on heating and contraction on cooling. The accomplished weldor recognizes this behavior and makes the necessary allowances in fits, jigging, welding sequence, judging heat input, etc. It is very difficult for the novice to grasp, but it must be understood before he will make a good all-around weldor.

Not much attention need be given to cast iron in production welding, but the welding of cast iron is an important problem in maintenance and reclamation. Unless the brittle nature of cast iron is understood, cracking will result when the weld cools. Another characteristic of this material is the behavior of its structure as it passes from the molten state to room temperature; unless its cooling is controlled, high hardness and brittleness will result.

The field of other engineering metals is so large that further comment must be foregone. The light metals, however, are increasing in importance and will call upon weldors for knowledge of their welding behavior in increasing volume. I mention these matters merely to show why a weldor trainee should devote a substantial amount of time to obtaining basic information on engineering metals. Studies of this nature should precede any attempt at actual arc manipulation.

Electrode Classifications

Welding operations require the use of some type of filler metal on the majority of occasions. The few designs such as flange joints where the weld metal is supplied for the weld are met with infrequently and, therefore, need not be given consideration here. In the more common butt, fillet and T-joints, the weld metal is supplied from an extraneous source—obtained in metal-arc welding from metal electrodes (referred to incorrectly as "weld rods"). Over the past few years the American Welding Society has taken a leading position in classifying electrodes. This development is of prime importance to engineering manufacture since it is now possible to specify the electrode for a given application without regard to the manufacturer. The weldor apprentice should learn these electrode classifications and their characteristics. Knowledge of this nature is much more fundamental than trade names and proprietary designations. It is a disservice to the industry to teach welding from the viewpoint of trade names for equipment and apparatus.

The source of electrical current is another salient part of weldor training. The subject should be presented on its merits rather than from personal prejudice as frequently happens. Direct-current welding was in favor prior to and during the late war, but since that time alternating current has moved forward. The prejudices that formerly existed against

a-c have been resolved. Electrode coatings are now available that overcome the arc-striking difficulties previously associated with a-c welding. The capabilities of each of these two major arc-welding methods should be thoroughly presented to the weldor trainee as should their shortcomings.

Arc Manipulation Ability

Nothing has been said here about the technique of actual arc manipulation. While this remains an important part of weldor training, it does not require the emphasis it formerly did. This is explained by the development of electrode coatings in large part. Some electrodes are offered on today's market that are said not to require any arc manipulation (contact electrodes) since the electrode need only be touched to the parent metal.

Ability to manipulate an arc that will develop sound weld metal is, of course, the ultimate test of an accomplished weldor. Since welding is done in several positions, the weldor needs to develop manual dexterity to a high degree. Learning by doing seems to be the only answer to this requirement. The trainee would be well advised to strive for weld metal free of contamination and under-cutting at the weld edge. This objective should take precedence over attempts to make the external appearance of the weld bead pleasing to the eye. It is not to be inferred from this that sound welding need have a rough appearance. All too frequently, however, the major consideration is given to weld bead appearance, whereas the emphasis should be placed on soundness of weld metal and joint penetration.

The matter of safety, which includes avoidance of hazards from both arc and welding current, is of such immense importance that it is deserving of major consideration in any weldor training program. The effect of heat on the base metal, both metallurgically and physically, needs to be explained. When this is properly understood, welding procedures that will care for heat distribution and thermal gradients can be developed, resulting in welds free from warpage and major stress concentrations.

Enough has been said. I believe, to show that even in a weldor training program, fundamental knowledge is basic. The purpose of this article has been to portray the fundamentals that are necessary to a sound weldor training program. When they are understood, there should be no difficulty in recognizing what the training of a competent weldor embraces.

Keeping up with the Taxes

No. 1. Bad Debts

BY HARRY H. ROSE

As a partner in the public accounting firm of Traeger & Rose, Cleveland, Harry Rose is an authority on "down-to-earth" tax law. His articles on tax topics will be a regular feature.

THE PRESENT law states a bad debt is deductible when it becomes actually worthless rather than when it was merely ascertained to be worthless, as under prior law.

When is a debt bad? Answers: bankruptcy; creditor's composition; collateral worthless; debtor without assets; debtor out of business; debtor disappeared; ill-health or death; statute of limitations. Mere uncertainty is no good.

Relationship of the parties is a factor against bad debt deduction; although a loan to a son or daughter could be proven to be a valid loan, it leans more to the gift conception. Other factors are: no serious effort to collect; debtor is still in business; debtor has good income; creditor is still selling to debtor (but balance could be an adjustment of the purchase price. If a stockholder, it could be a dividend if the corporation has an earned surplus.)

A taxpayer may go back seven years to get a refund for a bad debt deduction if on the charge-off basis. Regarding recoveries: under the tax benefit rule, a recovery is taxable only to the extent the original debt deduction resulted in a tax benefit. If on the reserve basis, it is a credit to the reserve.

The taxpayer, if he is on the charge-off basis, may charge off each year for partial worthlessness of specific debts, or he can wait until its collectibility is finally determined. Since proof of the amount of partial worthlessness is difficult, it would be better to wait until debt is totally bad unless you can furnish substantial proof.

A non-business debt is deductible only in the year it becomes wholly worthless.

The category of non-business debts applies only to individuals. It consists of debts NOT incurred in the taxpayer's trade or business and is treated as a short-term capital loss regardless of how long held. Loss limitation is $1,000, or loss may be offset against capital gains, and there is a carry-over for five years. Bad mortgages, deposits in defunct banks if not in the individual taxpayer's business account and even loans to business entities (unless taxpayer can prove that he is in the loan business) are regarded as not in his trade or business. In a current case, it was held a business bad debt where a shareholder had loaned money to a number of businesses in which he participated personally. (17 TC 17) However, occasional bad loans do not constitute business bad debts (Waybright, TCM 27461).

Bonds held are regarded as a capital loss, short or long-term, as of the last day of the taxable year in which they become wholly worthless. Here, too, the taxpayer may go back seven years for a refund. Partial deduction of bonds is not permitted. But bonds of a corporation's operating subsidiary are a bad debt loss when wholly worthless, rather than a capital loss (Sec. 23(k)4).

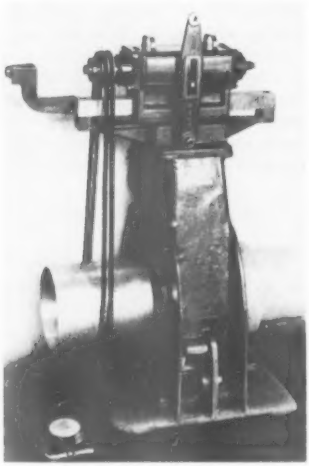
The taxpayer has a choice of two methods of bad debt treatment: the direct charge-off method and the reserve method. This writer prefers the reserve method. Then the taxpayer does not have to be strict as to the date of charge-off, as noted in the opening paragraph. Nor will he be bothered with special treatment for bad debt refunds, partial worthlessness or recoveries. For as long as the reserve is a reasonable approximation, based upon past collection experience of what the bad debt potential is, a valid basis for it exists.

Arc Welding Redesign Is

Evolution Not Revolution

"The song is ended but the melody lingers on" is very nearly an exact statement of what occurs when a changeover is made from a casting to a welded design.

BY R. P. LINDGREN
Welding Engineer, The Lincoln Electric Co.



1—ORIGINAL cast base for wire-straightening machine had heavy protruding flanges as shown here

WHEN America went from the 19th century horse and buggy to the passenger automobile, two major steps were entailed. Replacement of the horse with the gasoline motor—the first step—was relatively easy.

Getting rid of the buggy idea was something else again. Incredible as it may seem, some early autos continue to sport a whip holder. Gradually, the side curtains, the vase for artificial flowers and other fixtures of 1900 disappeared. Yet it was only in recent memory that the square, firmly-planted-on-the-ground appearance of the buggy gave way to the motor car as we now know it.

Human nature being what it is, the same steps are generally necessary in machine redesign. Where the changeover from castings to weldments has been deemed advisable, the initial step of putting the foundry fabrication method out to pasture is relatively easy. Impetus for this move is furnished by such indisputable facts as:

(1) Superior physical properties of the rolled steel used in welding over cast iron. The 60,000-psi ultimate tensile strength in tension of rolled steel compares favorably with the average 25,000-psi tensile strength of grey cast iron. Elasticity, both in tension and shear, again favors the rolled steel by some 200%. The 1% ultimate elongation of cast iron is insignificant in view of the 3,000% higher reading for steel. Other comparative figures are given in Table I.

(2) Elimination of pattern and mold expenditures—also the cost of design, maintenance, storage, repair and replacement of these casting essentials.

(3) Current scarcity of materials heightens the significance of the weight differential between the weldment and the cast structure it replaces. Generally, the welded machine weighs from 10 to 50% less.

(4) Today's spiraling costs add meaning to the considerable price difference between cast iron and rolled steel. The latter is usually about half as expensive, pound for pound.

(5) Design flexibility, lower labor costs, improved product appearance and other to-be-expected consequences of redesigning with weldments further operate to speed the initial transitional stage.

Table I. Physical Properties of Cast Iron and Rolled Steel*

	Cast Iron	*Mild Steel*	*Advantage of Steel*
Ultimate strength: tension, psi	25,000	60,000	240%
Ultimate strength: compression, psi	90,000	60,000	—33%
Yield strength: tension, psi	6,000	36,000	600%
Yield strength: compression, psi	90,000	36,000	—60%
Modulus of elasticity: tension	15,000,000	30,000,000	200%
Modulus of elasticity: shear	6,000,000	12,000,000	200%
Ultimate elongation, %	less than 1%	30%	3,000%
Reverse bending endurance limit, psi	10,000	30,000	300%
Working stress: tension, psi	5,000	20,000	400%
Working stress: compression, psi	15,000	20,000	133%
Working stress: shear, psi	5,000	15,000	300%
Relative toughness	70	15,700	22,400%
Modulus of resilience, in.-lb per cu in.	1.2	15	1,250%

*Adapted from the Lincoln Electric "Procedure Handbook of Arc Welding Design and Practice," 1950, page 429.

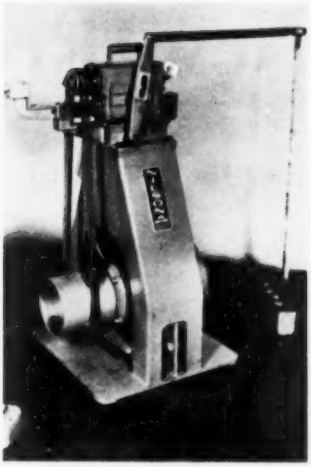
WHAT COMES NEXT?

Having decided on the welded structure, the natural tendency is to follow rather closely the design of the superseded casting, just as the holder for the buggy whip was continued on the early autos. Only after several trial models does the true welded design come into its own.

A case in point is the successful redesign job undertaken by the Boiler and Repair Welding Co., Bridgeport,

2—FIRST STEP in changing to a welded design was to copy the casting, duplicating the flanges

3—FINAL redesign achieved simplicity and the clean-cut lines so characteristic of a good weldment



4—HERE is the welded base with straightener mounted on top of it; compare this picture with Figure 1

Conn. Here the problem was to make over the base of a widely used wire-straightening machine manufactured by one of the firm's customers. The original casting, shown in Fig. 1, had protruding flanges. Because of the location of these flanges, the part was difficult and, consequently, costly to cast. Its design was largely influenced, not by the needs of the wire-straightening problem, but by the nature of the casting-fabrication method employed. Other shortcomings of the cast structure were poor appearance, relatively high finishing costs, excessive amounts of machining and design inflexibility.

In the initial redesign, shown in Fig. 2, the casting was duplicated down to the curving flanges, smooth interior and built-out exterior. From the standpoint of cost, the change-over was demonstrably successful. From an appearance viewpoint, however, the weldment was no great shakes.

The cost of the welded base was 15% less. Its weight was redistributed to provide increased stability, and its physical properties were greatly improved. The weldment was stronger, would resist greater shock without breaking, could support a heavier load, could withstand tensional stresses far higher than the earlier cast part. Furthermore, the welded structure could readily be altered in height or width (as well as in the placement of machine elements on it) to suit the requirements of individual customers. Such modifications were often impossible and if possible always expensive when castings were used.

Didn't Realize Advantages

Yet because the first design was influenced so strongly by its predecessor, it failed to realize fully the inherent advantages of welding. For example, a welded structure need not depend on ribbed members for strength and rigidity. These properties can be obtained far more simply by utilizing the "built-in" strength and toughness of steel. As can be seen, more than a few horse-and-buggy features remained on the first redesign.

Even more important, the structure shown in Fig. 2 did not utilize a minimum number of welds and a minimum amount of welding materials and weldor's time. That a well designed weldment would effect such economies is proved by the final redesign (Fig. 3), the one now being manufactured on a production basis.

The first redesign called for 13 separate parts, which were joined by 205 inches of welding. Welding time was approximately four hours, and total fabrication time was in excess of seven hours. The final redesign has only seven parts, joined together by 120 inches of welding. Less than six hours are now required for the complete fabrication.

In addition to its better appearance (with influence on sales), the final weldment has greater rigidity and durability.

The path from the wire straightener of Fig. 1 to the final redesign of Figs. 3 and 4 entailed numerous appearance and property changes. Gradually, the fussy frills and flanges of the casting were dropped. The structure gradually assumed the clean-cut lines so typical of well designed weldments. The improved appearance is not the result of purposeful seeking after modernity or slickness, but was achieved as the natural byproduct of making full use of the inherent simplicity and functionalism of welded fabrication.

Horse Killed Painlessly

At the Boiler and Repair Welding Shop, Inc., the change from horse-and-buggy casting to the modern welded structure followed the evolutionary rather than the revolutionary path. The steps were to: (1) build a model, (2) pause for careful evaluation, (3) note improvements that could be effected and (4) embody them in the next design. In this fashion, the horse was killed painlessly and the buggy reduced to kindling wood in a few weeks.

New Products . . .

Start off 1952 with a look at an air-inflated grinder, new welding fittings, torches and other welding aids

Scale-Free Coupling

THE Tube-Turn SF (scale-free) welding coupling has features claimed to prevent weld metal from getting inside the pipe as well as to protect the inside of the pipe from the extreme welding heat that causes scale formation.

The coupling consists of two forged halves, one having a tongue that fits into a groove on the other. A circumferential cavity directly beneath the beveled welding area prevents burnthrough or icicles and also provides an insulating area.

Hubs of the coupling are short and any spatter formed by the attachment welds can be easily reached and removed before the coupling is connected. The coupling can be taken apart when piping is to be disassembled and re-used. When properly welded, the coupling is permanently leakproof and as strong as the pipe itself.

The SF coupling is useful in piping carrying hydraulic fluids, steam, air, chemicals, fuel oil, carbonated beverages and food products. It is available in sizes from 1½-in. through 12-in. and in carbon steel, stainless, aluminum and other metals.

TUBE TURNS, INC., Louisville 1, Ky.

* * *

Brush-on Stainless Coating

"STEELCOTE" stainless-steel coating may be brushed or sprayed on metal surfaces to protect them from rust, corrosion and other types of deterioration. The solution dries to handle in 30 to 60 minutes and is completely dry in 3 to 4 hours. The color of unpolished stainless, the film is non-inflammable, odorless and tasteless.

STEELCOTE MFG. CO., 3418 Gratiot St. Louis, Mo.

* * *

Head-Mixing Torch

OXYGEN and acetylene are mixed in the head, rather than in the center block, of a new high-speed cutting torch, the Dockson Model D.

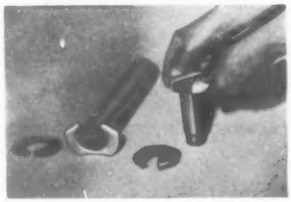
Locating the mixer in the head puts greater weight there, which Dockson utilizes to give the new torch a better balance for long steady work. Capacity of the torch ranges from light gage to 10-in. steel. Total weight is only 39 oz.

The head and valve blocks are die-forged bronze and all tubing is seamless—cupro-nickel for high-pressure oxygen, bronze for low pressure and fuel lines. Pure copper tips in sizes 0 through 8 have 4 or 6 precision-drilled preheat orifices.

Carefully machined flat-on-flat coupling of tip and head makes changing of tips easier and faster than with the customary cone-shaped, tapered seats. Long-life, high-pressure valve stems have been installed and press fitted to the handles. Self-sealing washers are used, and the high-pressure seats are located in a position that makes them easier to replace.

DOCKSON CORP., 3839 Wabash Ave., Detroit 8.

* * *



Flame-Sprayed Plastic

NEWEST method of masking portions of metal articles to be plated consists of flame-spraying a coating of polyethylene onto the section to be shielded. The plastic is non-porous and chemically inert. The plastic mask can be used again on similar parts by applying a special mold release agent prior to spraying. Equipment for the spraying is similar to that used in the welding of plastics.

AMERICAN AGILE CORP., Plastics Div., 5806 Hough Ave., Cleveland 3.

Air-Inflated Grinder

A NEW principle in abrasive wheel operation is said to speed weld metal removal by as much as 500%. In place of a solid backing wheel for an abrasive paper or cloth, an inflatable rubber drum is used.

Standard abrasive bands 3½-in. wide by 15½-in. are slipped over the drum when it is deflated. When the drum is expanded with 3 to 10 psi air pressure, the band is held securely in place.

Up to 30 times more abrasive contact area on flat surfaces, and 6 times more on contours, are claimed with this backing because the rubber drum is both resilient and air-inflated. No chatter or bounce is encountered and undercutting is also eliminated.

Safety feature of the drum is that any breakage results only in the rupture of the drum, noisy perhaps but not dangerous. Named "Nu-Matic" wheels, the drums are furnished with either ½ or ⅝ in. adapters and can be used on portable grinders, bench stands or other grinding set-ups. New drums are easy to install, as are all replacement parts.

NU-MATIC GRINDERS, INC., 8224½ Carnegie Ave., Cleveland 3.

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Tip sizes 00 to 10 (drill sizes 76 to 30). Universal mixer, or individual tip-mixer assemblies.

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All purpose. For brazing, welding, heating and cutting.

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Quickly attached. High flashback resistance. Cutting range 1/8" to 6". 75° or 90° head.

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Two-stage (shown) or single-stage. Dependable, safe, sensitive—stable flow. Large capacity, rugged construction.

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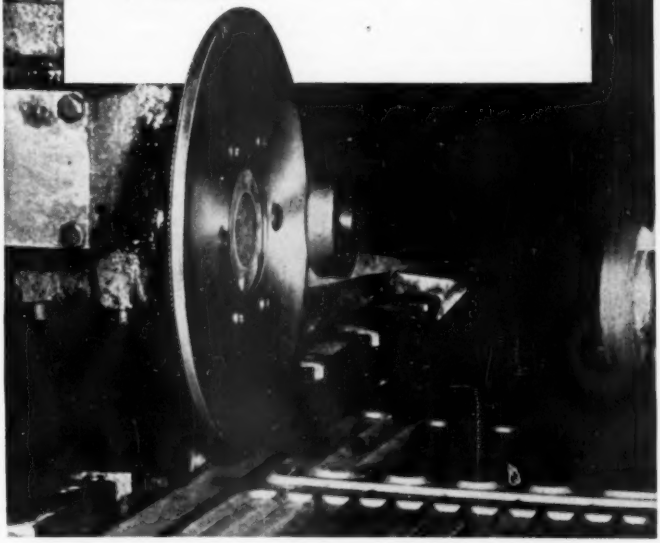
BERYLCO 50

RESISTANCE WELDING WHEELS USED BY NORGE

The Norge Division of Borg-Warner, maker of a famous line of refrigerators, employs Berylco 50 for its RWMA Class 3 seam-welding applications. On the evaporator welder, Berylco wheels give long service in joining 18-8 stainless steel, .027" thick. On the special 6-head welders which fabricate the inner box of the refrigerator from 20 gauge steel, both wheels and spline bars are made of Berylco 50. In this case, the spline bar serves as a fixture as well as a back-up bar. Berylco 50 plays an important part in the continuous high speed production demanded of these machines.



A big advantage of Berylco welding wheels, made of rolled stock, is their more uniform hardness, which prevents uneven wear and insures low maintenance with less down-time. It will pay you to consider Berylco 50 when selecting a resistance welding material.

BERYLCO BERYLLIUM COPPER IS AVAILABLE IN ROD AND BAR STOCK AND IN STANDARD SIZE WHEELS.

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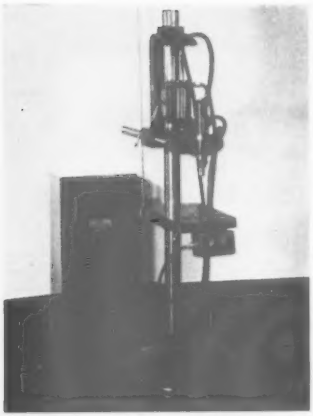


Production Stud Welder

As many as 15 to 20 stud welds per minute are claimed for a new standard production stud welder. Capacity of welder includes studs from ⅛ to ¾ in. in diameter and from ¾-in. up in length.

A special stud welding control cabinet includes a timer and air pressure regulator. Such accessories as an indexing table or an automatic vise can be easily plugged into outlets built into the cabinet. Power source for the control circuit is 110-volt, 60-cycle a-c, though the welder operates on d-c.

An 18-in. throat depth is available with the welding head. The shut height of the head can vary from to 30 in. and the head itself can be rotated 360 deg around the main column.

Dimensions of the stud welder are 18 by 30 by 16 in., weight, 210 lb. The control cabinet measures 21½ by 16 by 28 in. and weighs 125 lb.

Stud Welding Division, KSM Products, Inc., Merchantville, N. J.

* * *

Cast Welding Fittings

New welding fittings of cast alloy steel have a greater wall thickness at all points than other fittings and added thickness at stressed areas, says the manufacturer. "Key-Kast" fittings and flanges are also said to provide greater structural strength and a larger allowance against corrosion and erosion.

The new line meets ASA, ASME and ASTM standards and is available in low and intermediate alloys as well as various types of stainless steel. A boss is provided on all fittings for tapped openings.

Key Co., East St. Louis, Ill.

* * *

Multiple-Duty Vise

The "Multi-Vise", a 28-lb steel vise, also does duty as a pipe wrench, a welding clamp, a welding positioner, a drill jig or an aligning tool. It can be easily removed from its bench plate and carried to another location, say, on a truck, a welding table or a plumber's bench. Jaw capacity is 6-in. square, 5¾-in. round.

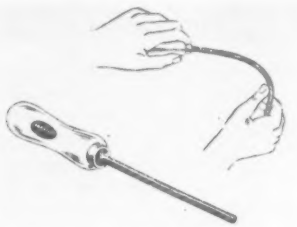
Available in three models, this vice has a 360-deg vertical swivel, a horizontal swivel or a double swivel on both vertical and horizontal axes.

In the welding shop, a "multi-vise" will realign split frames and hold them rigidly for welding, will aid in layout work on sheet metal fabrication, will aid in assembling or disassembling pipe or machinery.

A 12-in handle hinges in a spindle to give high speed when opening or closing jaws as well as great leverage when a part must be tightly clamped.

American Implement Co., 2523 Taylor St., Omaha, Nebr.

* * *



Files around Curves

New round abrasive file can be bent cold to almost any curve. It can be used to clean concave surfaces, to smooth pipe bends or to rasp off inside surfaces in castings. The teeth are said to be a special non-clogging shape that will not fill up on lead, aluminum or plastic.

Tec Imports, 14404 Addison St., Van Nuys, Calif.

* * *

Special Welding Light

Weldors working in dark and confined spaces or aloft on towers at night can now obtain a useful special light to aid their vision. The "Arklit" consists of a portable electric light bulb in a shielded fixture attached to a magnetic base. It is connected to a welding electrode holder through a 6-ft electric cord. The magnetic base permits the light to be positioned anywhere on the metal workpiece.

Idea for the "Arklit" came to John Salm, a weldor with 40 years' experience, in 1936 when he was welding four 160-ft high smokestacks at a Florida sugar works. Heavy tradewinds during the day forced Mr. Salm to commence his welding as early as 3 a.m., when the light was not sufficient for good welding. At that time, he made a makeshift light out of a locomotive bulb, socket holder, clamp and electric cord.

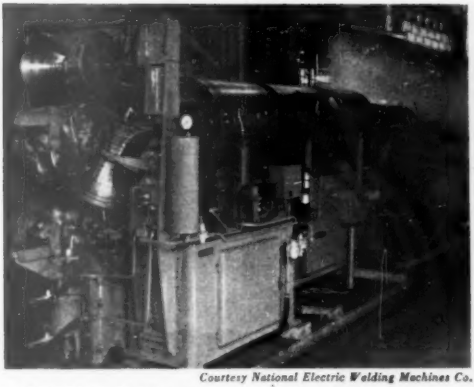
Norman Snyder, 14 Genessee St., Oneida, N. Y.

* * *

SAFETY RECORD SIGN acts as a constant reminder of days worked without a lost time injury and keeps up daily interest in record. Industrial Products Co., 2802 No. Fourth St., Philadelphia 33.

(More New Products on Page 90)

on the job



Courtesy National Electric Welding Machines Co.

AUTOMATIC high-speed machine forms and seam welds 55-gallon drums. Lubricating system is also automatic

Courtesy Linde Air Products Co.

PLASTIC coating is sprayed on a mild-steel tank to protect it against corrosive effects of muriatic acid

Case Example 1: high conductance

Fine Wires Spot Welded

Two case examples of low-capacity spot-welding jobs at Westinghouse Electric Corporation's Lamp Division, Bloomfield, N. J., indicate the importance of accurate weld timing for delicate work.

Case Example 1: This weld, being made between tweezer prongs, joins a 0.010-in. wire to a 0.010-in. nickel-plated brass sheet on a telephone switchboard lamp. Accurate weld time is essential to prevent wire burnout and still make a good joint between the high-conducting, copper-bearing materials being welded. The welding operation replaces a soldering operation that cost twice as much.

The wire is of "dumet," a borated, copper-coated, nickel-iron alloy. A short, high-voltage pulse is provided by a synchronous spot timer to break down the insulating borax coating. This unit is a one-half cycle weld timer designed to weld such high-conductance materials as aluminum, copper and copperplate. Besides precision timing, the unit has a heat control that enables welding current to be adjusted from 20 to 100% of full heat at one-half cycle.

Case Example 2: low conductance

Case Example 2: Accurate timing is also essential in welding such refractory metals as tungsten and molybdenum. In this example, synchronous timing has improved quality and reduced rejects for the filament of a type WL-2400 automotive headlight lamp. Both legs of the lamp are welded simultaneously, using a synchronous timer designed for low-conductance materials. Weld time is adjustable from 1 to 10 cycles.

Plastic Coating Flame-Sprayed

To use as a container for muriatic acid, a tank 4 by 5 ft by 3½ ft deep was constructed from ¼ and 3/16 in. mild-steel plate. No defects were noted in the tank after it had been holding acid for six weeks.

You're right! Something does sound funny about the above paragraph. We neglected to state that the tank was flame-sprayed with polyethylene plastic before it went into service.

The job was done by the Southern Lead Burning Co., Atlanta, Ga. Before being coated with polyethylene, the tank was sandblasted to: (1) remove rust and other impurities and (2) roughen the surface to improve the mechanical bond between the metal surface and the flame-sprayed coating.

A flame-spraying gun was used to apply the polyethylene and also for preheating, which is necessary in polyethylene flame-spraying. After the preheating, a coating approximately 0.05 in. thick was applied, several passes being needed to build up the coating to this thickness. The speed of the flame-spraying on each pass was comparable to the speed of paint spraying.

The coating was tested for porosity with a spark gap tester. Since polyethylene is thermoplastic, the coating could have easily been patched if any porosity had been discovered. However, no porosity could be found. Moreover, tests after six weeks of muriatic acid service showed no corrosion of the mild-steel plate, no damage to the tough, flexible coating.

SOLVED BY NELWELD

TRANSFORMER MAKER FINDS
Continuous SAVINGS
IN STUD APPLICATION

Split-second welding of studs to distribution transformer housing. Note ease with which operator uses portable Nelweld gun to weld to plate.

Continuous production savings — in fabricating time, in materials used and in release of production equipment—describes the Nelweld advantages gained by a manufacturer of power transformers.

Nelweld methods and the light-weight, portable Nelweld gun enable workmen to install studs in any position on the work at a rate of 4 or 5 per minute.

These same methods save time and materials by eliminating drilling and tapping procedures for threaded studs, and reinforcing of light gage castings to obtain tapping depth.

This results in reduced materials handling, lighter, stronger, and more weatherproof casings, plus the release of production manpower and equipment to other work.

Manufacturers everywhere are replacing time-consuming procedures (and the resulting tie-up of drilling and tapping equipment) with modern, fast-production Nelweld methods. The same advantages can improve your production efficiency.

For complete information on the advantages of Nelweld as applied to your fabricating problems, contact the nearest Nelson office or write Dept. W-1, Lorain, Ohio.

Fasten it Better...at Less Cost, with NELWELD

T. M. REG.

NELSON STUD WELDING

DIVISION OF GREGORY INDUSTRIES, INC., LORAIN, OHIO

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White Plains, N. Y.

Horsepower for Hydraulic Cylinders

When any straight line, which may be called an alignment line, is drawn across the three scales on the accompanying chart, the values indicated on each scale at the respective points of intersection have a very definite relationship with each other.

These values are tied together by the formula

HP = .0005833 x P x G in which

HP = horsepower,

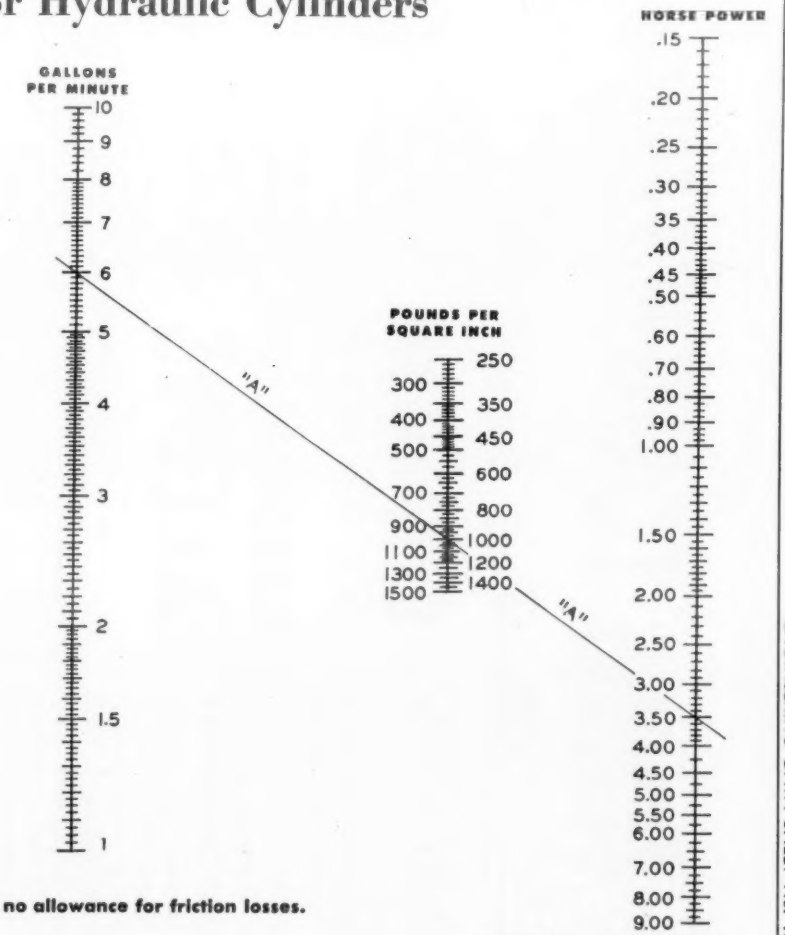
P = pressure of the liquid in pounds per square inch, and

G = rate of flow of the liquid in gallons per minute.

When any two of these values are known the third value can be determined from the chart.

To illustrate, the line "A" - "A" on the chart indicates that a flow of 6 gallons per minute at a pressure of 1000 pounds per square inch requires 3.5 horsepower.

The chart may be used for pressures and pumpage outside the range of the scales. For example, should the pumpage required be 60 gallons per minute at 1000 pounds pressure the horsepower required would be 60:6 or 10 times as great—that is 35 horsepower. On the other hand should the pressure be 200 pounds per square inch at a pumpage of 6 gallons per minute the required horsepower would be 200 : 1000 or one-fifth of 3.5 horsepower—that is 0.7 horsepower.



This chart makes no allowance for friction losses.

Courtesy Hanna Engineering Works

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HARD-FACING ALLOYS

VICTORALLOY

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tools subject to abrasion and severe impact

TYPICAL APPLICATIONS

Tractor rollers and idlers; dredge pumps and cutters; bucket lips and teeth; rock crushers; steel mill wobblers; sheepsfoot tampers; etc.

Electric AC

VICTOR Hard-Facing Alloys give you faster application, smooth deposits, longer wear. Order from your VICTOR dealer TODAY.

VICTOR TUBE

for severe abrasion

TYPICAL APPLICATIONS

Bulldozer tips; grader blades; scarifier teeth; posthole augers; ditcher teeth; oil drilling bits; pug mill knives; asphalt mixer blades; etc.

Gas and Electric AC-DC

VICTOR TUNGSMOOTH

for

thin and smooth cutting edges

TYPICAL APPLICATIONS

Hand shovels; coal cutter bits; auger points; shredder knives; screw conveyors; pug mill blades; ensilage knives; plow shares; drill bits; etc.

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FREE LITERATURE—

Catalogs · Booklets · Bulletins

A Welding Engineer Reader Service

1 NEW WELDING COUPLING—Tube Turns, Inc., Louisville 1, Ky. Literature tells about the new "SF" (scale-free) welding coupling that is claimed to eliminate welding spatter from piping systems. Its tongue-and-groove design and other improved features are pictured and their purpose explained. See page 60.

2 HARD-FACING APPLICATIONS—American Manganese Steel Div., Chicago Heights, Ill. Printed on heavy paper, a new rod selection guide for Amsco hard-facing products tells the proper alloy for more than 65 separate applications in agriculture, metal-working, mining, crushing, excavating, materials handling and power transmission fields.

3 TOGGLE CLAMPS—Detroit Stamping Co., Detroit 3. 16-page bulletin 52-A tells the whole story on "De-Sta-Co" toggle clamps for holding weldments in accurate alignment. Many different sizes and models of clamps are presented in outline drawing and photo, including stationary and portable types.

4 STUD WELDER—KSM Products, Inc., Merchantville, N. J. Single-sheet bulletin tells about a stud welder for production line work, its timing control, air pressure regulator and power requirements. Such accessories as an indexing table are discussed as are the higher welding rates thus possible. See page 62.

5 SPOT WELDERS—Peer, Inc., Welding Equipment Div., Benton Harbor, Mich. 12-page, two-color bulletin gives construction details and operating advantages of Peer spot welders, foot-operated, hand-operated, air-operated rocker arm and press type models. Data on electrode forces, electrodes, copper horns and water-cooled holders is included.

6 WELD CLEANING HAMMERS—Atlas Welding Accessories Co., Detroit. Single-sheet, two-color bulletin features the "Re-Bit" replaceable bit weld cleaning hammer and chipping tool. Special designs for better cleaning efficiency are diagrammed and explained. Also shown are six models of "Tomahawk" chippers and symbol hammer.

7 GAS WELDING CATALOG—Victor Equipment Co., San Francisco 7. 64-page super-complete catalog of gas welding and cutting equipment covers everything from "A" (adapters) to "V" for "Victrometers" (industrial flowmeters). Diagrams, listings, photos, three-color illustrations and tables describe every piece of equipment, accessory, coupling, hose, cleaner and bushing used with welding equipment.

8 DESIGN FOR WELDING—Linde Air Products Co., New York City 17. 20-page illustrated booklet describes the economies of good welding design. Included are reprints of papers by G. F. Nordenholt, editor of *Product Engineering*, and R. H. Bennewitz of Linde. A summary of standard welding symbols is also included.

HOW TO ORDER: Fill out one of the small card sections completely (name, address, your company, etc.) for each piece of literature you would like to have. Each card section must be completely filled out; do not use ditto marks. Each circle must contain the number that appears with the item on which you desire further information.

THE WELDING ENGINEER will request manufacturers to send readers the literature in which they are interested. Two post cards are printed here, each containing space for four items.

These cards not good after April 1, 1952

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Your Company Jones Mfg. Co.

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THE WELDING ENGINEER

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THE WELDING ENGINEER

520 NORTH MICHIGAN AVE.

CHICAGO 11, ILL.

9 METAL CLEANING — American Chemical Paint Co., Ambler, Pa. 4-page data sheet No. 3-1-1-2 tells about "Deoxidine" metal cleaner and rust remover for weldments, sheets, forgings, dip cleaning, spray or brush application. Other company products for treating and protecting metals are also listed.

10 WELDING DESIGN—Eutectic Welding Alloys Corp., Flushing, N. Y. Fourth edition of Eutectic's Manual of Welding Design and Engineering contains 72 pages including 62 new photos and 132 new drawings besides tables on melting temperatures, corrosion factors, physical properties and application data for welding cast iron, steel, copper, brass, aluminum, nickel, magnesium, etc.

11 MOVABLE FRAME PRESS—Dake Engine Co., Grand Haven, Mich. Bulletin No. 269 tells about Dake movable frame presses for pressing, bending, straightening parts so bulky they must be moved by overhead crane. Operating advantages in the various capacities are described. See page 90.

12 ULTRASONIC TESTING — Sperry Products, Inc., Danbury, Conn. Bulletin 50-115 tells about Sperry field service with the "Reflectoscope" and "Reflectogage" non-destructive testing equipment. A lab service is offered when it's possible to ship materials to Danbury. The ultrasonic equipment is used to inspect check welds and make maintenance checks on axles, bearings, and pressure vessels.

13 SILVER CLAD METALS—American Silver Co., Flushing 54, N. Y. 4-page bulletin explains how good silver brazed joints and simplified silver brazed assemblies can be obtained by using metals clad with a silver brazing alloy. Applications shown are tubing, hollow blades, carbide tool tips and radio tube assemblies.

14 ALUMINUM BRONZE ALLOYS—Ampco Metal, Inc., Milwaukee 46. Revised bulletin PI-3 in two colors gives valuable information on aluminum bronze alloys for corrosion-erosion resistance. Cavitation-pitting data, physical and chemical properties are tabulated as well as applications on pumps, valves, pipes, tube sheets, etc.

15 WELDING POSITIONERS—Worthington Pump and Machinery Corp., Dunellen, N. J. 40-page bulletin R-210D is an excellent presentation of the advantages of positioning weldments and includes many fine photos and diagrams that explain each advantage. Positioners ranging in capacity from 100 to 40,000 lb are shown in actual use and are accompanied by complete specifications as to power, speed, flexibility and special features. Two tables on proper working speeds and load capacities are noteworthy.

16 ELECTRODE SELECTOR—General Electric Co., Schenectady 5, N. Y. Condensed information on recommended electrodes for the welding of mild steel, stainless, low hydrogen low alloy steel, high tensile steels, cast-iron and bronze is handily provided in a new electrode selector chart GEC-657B. Comparison lists of various manufacturer's electrodes are included.

17 FAST WELD GRINDING — Nu-Matic Grinders, Inc., Cleveland 3. Two bulletins give operating principles and performance data on air-inflated grinding and polishing wheels for the weld and foundry shop. Specifications and abrasive-belt information are also listed. Page 60.

18 HEALTH IN WELDING — Metropolitan Life Insurance Co., New York City 10. 30-page booklet *Health Protection in Welding* is a complete, though brief discussion of the ventilating, protective clothing and eye protection devices necessary for good health in welding. Subjects covered include poisonous fumes, leather clothing and tinted goggles and eyeshields.

19 HOBART FACTORY—Hobart Brothers Co., Troy, O. 40-page pocket-size booklet is a pictorial record of all Hobart production, research, experimental and development facilities. Photos show materials in process from the warehouse, through punch and forming presses, through winding department and down final production line.

20 PLASTIC COVER LENS—Thermacote Co., Los Angeles 21, Calif. Test results published by California Testing Laboratories show the outcome of experiments under simulated welding conditions of plastic-coated lenses versus all-plastic lenses. Data and photos show the comparison.

21 HARD-FACING ELECTRODES—Mir-O-Col Alloy Co., Inc., Los Angeles 31. Electrode comparison chart tells about eight Mir-O-Col hard-facing rods and electrodes for eight specific applications. Nineteen other makes of hard-facing electrodes are also listed for the various uses.

22 HOW TORCH WORKS—National Welding Equipment Co., San Francisco 5. Handy book for gas welding students is a simple treatise on how a welding torch works. Unique illustrations depict the mixture of gases, the different types of flames, etc.

23 HARD-FACING ELECTRODES—Stulz-Sickles Co., Newark 5, N. J. Tips are given on using Seaco a-c/d-c hard-facing electrodes for maintenance on hammermill hammers, carbon or alloy steels, new manganese steel on shovel teeth, etc.

THE WELDING ENGINEER will request manufacturers to send readers the literature in which they are interested. Two post cards are printed here, each containing space for four items.

These cards not good after April 1, 1952

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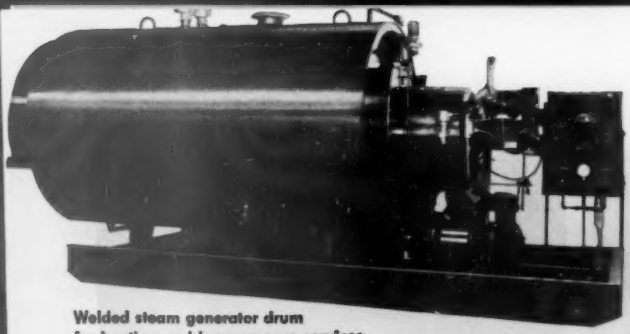
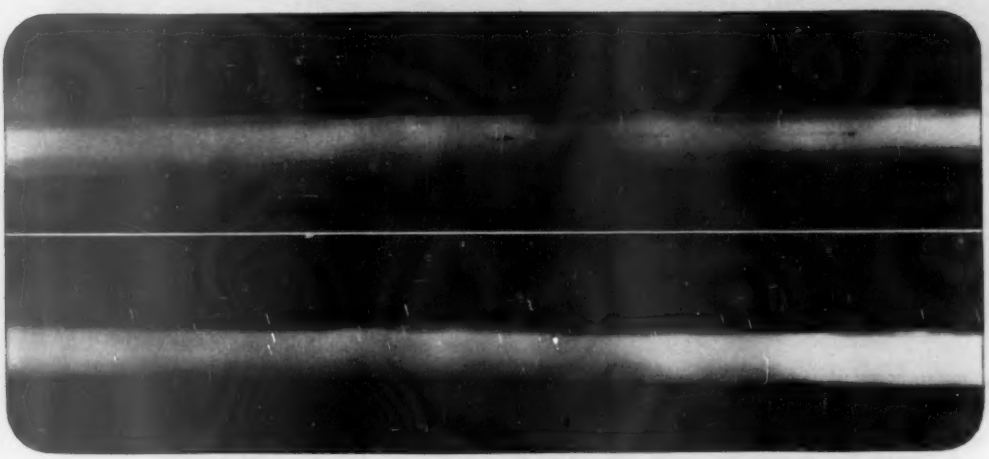


Welded steam generator drum
for heating and low-pressure services.

Dependability up—cost and weight down—



thanks to RADIOGRAPHY

BECAUSE radiography proves it sound, welding can be used for making better pressure vessels. And with results such as these: In these steam boilers approximately 15% in weight was saved—costs dropped 10% to 20% dependent on design pressure.

Easy to see, isn't it, how radiography opens new fields for welding—why it increases business.

Radiography is quick to detect any serious lack of fusion or gas porosities in a weld. It can help you make sure only top-quality work leaves your shop.

If you would like to know more about how it can help you, get in touch with your x-ray dealer and talk it over.

EASTMAN KODAK COMPANY
X-ray Division • Rochester 4, N. Y.

Radiography . . .

another important function of photography

Kodak
TRADE-MARK

100 MILES OF WELDED seams join plates of 666-ft hull of *John G. Munson*, shown at recent launching

HEFTING some electrodes at Saginaw Welding Supply open house: Bill Rice, Bob McCracken, Milan Wagner

NEWS

"Jungle Jim" Welder Helps Build the *Munson*

A BIG submerged-arc welding rig known as "Jungle Jim" speeded the completion of the *John G. Munson*, 666-ft self-unloading limestone carrier built at Manitowoc, Wis., before winter sealed the river. Launching was right on schedule (Nov. 28) because the big welder and a score of arc welders joined the plates faster and better than would otherwise be possible.

A massive machine in its own right, "Jungle Jim" looks more like a lifting crane than a conventional automatic welder (see front cover). It carries submerged-arc welding equipment on the vertical mast near the operator. Tall cylinders near the rod coils serve as hoppers for the granular shielding flux.

The *Munson* is the largest ship ever built at the 80-year-old yards of the Manitowoc Shipbuilding Co. and the largest of seven ships owned by the Bradley Transportation Co., a U. S. Steel subsidiary. It will carry limestone down to lower lakes ports steel mills from limestone quarries at Calcite, Mich. Taking some 650,000 manhours of labor to construct, the big self-unloader contains more than 100 miles of welded seams, 6 miles of piping, and 180,000 rivets. It also involved the use of 1,033,000 board feet of timber for staging, blocking, shores, etc.

The old system of building a ship piece by piece was abandoned in the construction of the *Munson*. Instead, a system of prefabricated parts was adopted. The breakdown into subassemblies consisted chiefly of huge sections of the hull's double bottom, side tanks and transverse arches complete with the spar deck plating between the hatches. The largest single unit to be subassembled was the stern section, a 127-ton section built upside down to facilitate welding. The *Munson's* 12-ton rudder (being welded in this month's cover illustration) is built upon a skelton of flame-cut steel plates varying in thickness from ¾ through 1½ in. The rudder is 2 ft thick, 11 ft long and 24 ft high.

Launching was a colorful ceremony, with music provided by the Manitowoc Marine Band and more than 10,000 spectators watching from the banks and specially built bleachers. Hundreds of children were present because schools had been let out for the big event. Television, radio, newsreel, newspaper and magazine representatives were on hand to record the launching. A special train from Chicago brought 162 press representatives, U. S. Steel executives and other guests to the scene.

Self-unloaders are so called because they carry their own unloading gear, usually a conveyor belt and boom arrangement. They are not dependent on dock equipment or dock workers. The *Munson* is the largest such ship on the Great Lakes and will carry 20,000 gross tons of limestone at a speed of 16 mph. A coal burner, it is powered by a 7,000-hp turbine engine. It will go into service this year shortly after its scheduled test run in April.

* * *

Saginaw Welding Supply Entertains NWSA Visitors

CO-OWNERS Jim and Rose Alcock of Saginaw Welding Supply Co., Saginaw, Mich., played host and hostess to some 150 guests, most of whom were attending the zone meeting of the National Welding Supply Association in Detroit at that time.

The Alcocks have been in business only nine years but in that time have grown from a 1,000 sq ft location to a present building space of 7,200 sq ft. Though the business was started with $1,500 capital, present stock is valued at $52,000 and the annual business volume is more than $330,000.

In 1945, Mr. Alcock joined the new firm of Wolverine Gas Products, Inc., as vice-president and treasurer. This company makes acetylene, oxygen and nitrogen for industrial uses.

"Visible merchandising" is a special technique in the Alcock welding business (see THE WELDING ENGINEER, May, 1949, page 22). The firm is a pioneer in the methods of putting welding accessories out where they can be seen and sold in a hurry.

Alcock is a past zone vice-president and director of the National Welding Supply Association and is a past president of the Saginaw Exchange Club.

RWMA to Give $2,250 in 1952 Contest

THE 1952 prize paper contest of the Resistance Welder Manufacturers Association will offer a total of $2,250 in prizes for outstanding papers on resistance welding. Men in industry or in research laboratory work may compete for a first prize of $750, a second prize of $500 and a third prize of $250. Papers from a university source (the author being an instructor, graduate student or research fellow) are eligible for a $300 prize and a $200 one. Undergraduate students may submit papers for a $250 award.

The contest is open to anyone without restrictions in the above categories in the United States, its possessions and Canada. The judges will be appointed by the American Welding Society and awards will be made at the 1952 fall meeting of the AWS. For complete details and contest rules, write to the RWMA, 1900 Arch St., Philadelphia 3.

* * *

Welded Off-Highway Trucks Made at California Plant

FEATURING an automatically welded frame, the first Mack off-highway truck assembled on the Pacific coast recently rolled from the production line of the Wooldridge Mfg Co., Sunnyvale, Calif. Under a five-year contract signed last year with Mack Trucks, Inc., New York, the Sunnyvale company has been making welded frames for the trucks for several months. Most of the welded frames will be assembled by Wooldridge into four models of off-highway trucks with the excess going east for assembly there.

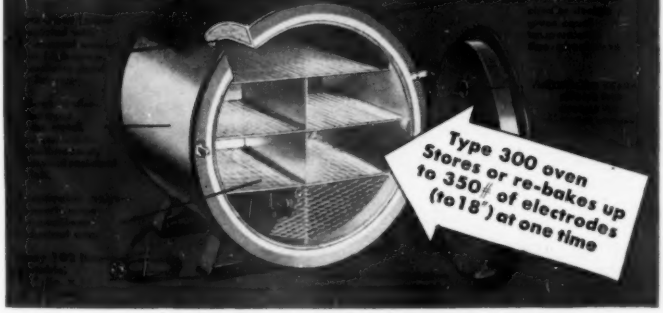
The 200 hp, 15-ton capacity "first" is the smallest Mack model that will be assembled by Wooldridge; the largest will be a 400 hp, 33-ton capacity truck. Wooldridge has exclusive distribution rights in 10 western states under the Mack contract.

* * *

Army Award Given NPA Welding Official

PRESTON M. Hall, Rogers Heights, Md., was awarded a Certificate of Appreciation by the Department of the Army on Nov. 13. Hall, who was honored for representing the welding industry in a mission through Sweden, England and Germany after World War II, presently administers the resistance welding program for the National Production Authority.

New DryRod Electrode Oven



gives 4-way savings to users of low hydrogen, stainless steel electrodes

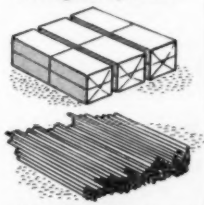
For a few cents a day DryRod protects mineral coatings against moisture absorption. Gives you a low-cost system of control for better welds at point of use.

1. **Stops rod scrap loss—** normal temperature range (175-325°F) safe-holds freshly unpackaged rods. Higher range (325-550°F) re-bakes those exposed to humidity for longer periods.
2. **Eliminates costly rework—** with *dry* coatings you can *be sure* of high quality welds. Stops under-bead cracking, X-Ray porosity, rough welds, rework.
3. **Faster welding—** preheating plus drying gives electrodes *consistent* quality . . . higher production per hour . . . lower unit costs.
4. **Efficient, safe storage—** orderly, convenient, mobile...provides electrodes in the right condition at time and place needed.

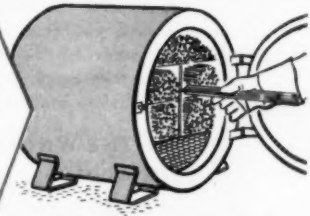
First in the field and designed with assistance of electrode manufacturers, DryRod is saving money and time for leading fabricators across the country. Write NOW for all the facts.

How DryRod System of electrode control saves you money

Packaged they're safe



1-POINT STORAGE
Once sealed cartons are opened and electrodes placed in the DryRod, protection is automatic . . . original "baked-in" quality is consistently preserved. Speeds up production . . . oven is always convenient to welders for replenishing stock.



Unpackaged they're perishable

Always ready for convenient use

Philip Roden Co.

DryRod *Electrode Oven*

1721 E. Lake Bluff Blvd.
Milwaukee 11, Wis.

WRITE FOR FULL INFORMATION

Philip Roden Co.
1721 E. Lake Bluff Blvd., Milwaukee 11, Wis.

☐ Send bulletin DR-1A, describing Type 300 Oven

☐ Send chart showing recommended temperatures for various types of mineral-coated electrodes

Name_____

Company_____

Address_____

City_____ State_____

PR-2 DryRod — Trademark

EASY-FLO

scores high in gun production

A whale of a lot of EASY-FLO is used in gun production because—this low temperature silver brazing alloy just naturally makes joints fully as strong and resilient as solid metal. In fact, the metal usually breaks before the joint.

Today, EASY-FLO is helping produce all kinds of war guns, big and small, and sporting rifles, shotguns and pistols. Below is just one example of the kind of jobs on which EASY-FLO excels.

Pistol photos and data courtesy of Crosman Arms Co., Inc., Rochester, N. Y.

CROSMAN CO_2 PISTOL—Compression chamber is pressed into tube and accurately positioned with locating pin. Assembly is induction heated and 1/8" EASY-FLO wire is hand fed around pin. Front sight is brazed to tube with EASY-FLO shim preplaced under sight before heating.

GET THE WHOLE STORY IN BULLETIN 20

This bulletin is a "must" for metal product designers and production men. It explains why speed, strength and economy are inherent in EASY-FLO brazing—and it's packed with useful information on joint design and fast production brazing methods. Write for a copy today.

HANDY & HARMAN

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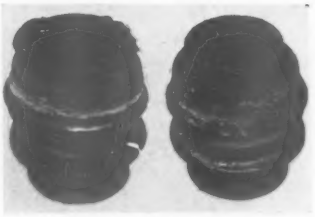

WELDING two edges of socket avoids scrapping entire assembly

Mechanic Earns $1,000 With Welding Suggestion

SAVING Trans World Airlines money on aircraft engine parts earned master mechanic Jay Losey a thousand dollars (before taxes). When Losey installed engine exhaust collector ring ball sockets he noticed they had two separate layers of metal around the upper rim. After an engine overhaul, the outer metal lip was broken, flared out and the socket wasn't worth salvaging. By welding the two metal layers together before the socket was installed, mechanic Losey found that the entire socket was reusable after overhaul, says *Aviation Week*, a McGraw Hill publication.

* * *

Automatic Welding Service Offered by Caterpillar Dealers

WITHIN the last year, it has been proved feasible to resurface track links automatically because of the development of equipment to correctly space the deposits on the assembled links. Rebuilding of track link assemblies by the use of submerged-arc welding is now being done through the dealer outlets of Caterpillar Tractor Co. Previously, it was necessary to take apart the links and hard-face each by hand.

About a year ago, Caterpillar dealers began resurfacing tractor rollers and idlers on a 'round-the-clock basis. This is accomplished on a rotating positioner with a submerged-arc welding machine mounted above it.

Automatic equipment for the links, however, is another matter and is presently at a low production rate because of shortages of component parts.

* * *

Sutton-Garten Company To Distribute Tuffaloy

WELDING Sales & Engineering Company, Detroit, maker of "Tuffaloy" resistance welding products, has appointed the Sutton-Garten Co., Indianapolis, Ft. Wayne and Richmond, Ind., as exclusive distributor for Indiana.

Welding Saves 14% in Turbine Casings

THE general trend in turbine design is toward a reduction in overall weight and cost by use of welded plate steel construction and by increasing the casing inlet velocities, said W. J. Rheingans recently at the annual meeting of The American Society of Mechanical Engineers. Mr. Rheingans, who is manager of Allis-Chalmers' hydraulic section, talked before the hydraulic session of the Atlantic City meeting.

Use of welded plate steel for spiral cases in place of cast steel has shown possible savings of 14% in overall weight and 13% in total cost of the turbine, he said. The finished welded plate steel casing weighed 30% less than the cast steel casing and cost 20% less to manufacture.

Overlays of stainless steels and aluminum bronzes are being used to resist pitting corrosion and erosion on turbine components built by a-c. Experiments are being made using an inert-gas-shielded welding process to make stainless overlays. Advantages are said to be a reduction in welding time, slightly less cost and smoother zone vice-president, presided over the grinding.

* * *

Air-Inflated Grinders Boost Production Marks

A NEWLY developed grinder having an inflatable body is claimed to have lifted production of sheet-metal parts by as much as 500% at Arrow Enterprises, Cleveland. The firm formerly used flat sanding discs to remove excess weld metal on the corners of boxes and other shapes. This necessitated a rough finish with No. 24 grit and then a switch to No. 20 grit for a finish operation.

With a single grit size (No. 60) and the air-inflated grinding wheel, the same job is done much faster and leaves no swirl marks as did the sanding discs. An additional advantage of the new grinding wheel is its inability to chatter or bounce under pressure.

* * *

New G-E Distributor for Macon, Georgia

WELDING Supply and Service Co., Macon, Ga., has been appointed a distributor for electrodes, welders and accessory items of the General Electric Welding Department. A G-E distributor in Atlanta for many years, the Welding Supply and Service Co. began operating from its new Macon store in November. M. T. Wilcher and C. A. Walker will be in charge of the new distributorship.

Make Quick and Lasting Repairs with
BRIDGEPORT'S No. 192
LOW FUMING BRONZE ROD

Braze welding is one of the most economical and fastest ways to get broken or cracked parts back on the job, often stronger than originally designed. This high pressure water pump frame for a rod extrusion press was repaired with Bridgeport's No. 192 Low Fuming Bronze Rod in short order and returned to service with minimum shut-down loss.

Braze welding eliminates over-all preheating. The break is cleaned and prepared, then heated only to redness. Besides its excellent "filling" and "tinning" action, Bridgeport's No. 192 Low Fuming Bronze Rod produces a clean, non-porous deposit with very high tensile strength and good shock and wear resistance.

"Bronze Welding Alloys" booklet contains a wealth of information on braze welding, and the many Bridgeport welding alloys available. Write for your copy, today.

"Bridgeport" BRASS
BRIDGEPORT BRASS COMPANY
Bridgeport 2, Conn. Established 1865
Mills at Bridgeport, Conn., and Indianapolis, Ind.
In Canada: Noranda Copper and Brass Limited, Montreal

Bronze Welding Rod A PRODUCT OF
BRIDGEPORT BRASS

NO MATTER WHAT METALS...

there's a GB silver brazing alloy and flux combination that will *Speed Your Production!*

SILVER
COPPER
BRASS
STAINLESS STEEL
BRONZE
STEEL
NICKEL
CHROME ALLOYS
GOLD
TOOL STEEL
CARBIDE
INCONEL
ETC.

Every day more and more fabricators are learning that GB Silver Solder with GB Flux makes an unbeatable production team for low temperature brazing.

From the GB line of six standard silver solders you can select the one which will fully meet your production specifications. Yes, with GB Silver Solders you get sound, low-cost joints on virtually any ferrous or non-ferrous metal.

GB Standard Silver Solders:

GB No. 50 Silver Solder, melting range 1160-1175°F
GB No. 50N Silver Solder, melting range 1240-1260°F
GB No. 45 Silver Solder, melting range 1125-1145°F
GB No. 41 Silver Solder, melting range 1125-1160°F
GB No. 35 Silver Solder, melting range 1130-1270°F
GB No. 31 Silver Solder, melting range 1130-1300°F

For special jobs where special silver solders are required, GB offers you competent technical assistance, backed by over 80 years of experience in alloying and refining precious metals.

GB FLUXES

The physical properties and appearance of a brazed joint are controlled to a large degree by the flux which is used. For this reason it will pay you to team-up GB Flux with GB Silver Solder — they were developed to produce maximum results when used together.

GB DATA BOOK

Here's real factual data on all of the important phases of low temperature brazing. You can get a free copy from your GB Distributor — Write us and a copy will be forwarded to you.

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1304 W. 59th Street, Chicago 36, Illinois
Suppliers of Precious Metals to Industry Since 1867

March of Dimes Needs Bigger this Year

THE National Foundation for Infantile Paralysis has to enlarge its 1952 drive from two weeks to a full four weeks this year, because of the severe polio incidence in the last three years. The drive for funds will last from Jan. 2 to Jan. 31. The final 1951 figures aren't in yet, but the 1950 epidemic struck 33,351 children and adults.

* * *

Heat Starts Cylinder on Jet-Propelled Flight

A 35-LB carbon dioxide fire extinguisher recently proved to bystanders that compressed gas cylinders should always be kept away from the hot sun or indoor high heat sources. This particular extinguisher was placed in an upright position in a scorching sun. Because of the pressure rise from the heat, the gas control presumably fractured.

The cylinder took off like a bat, straight up with its carbon dioxide jet propelling it like a rocket. The heavy cylinder traveled 115 ft, struck a piling, traveled another 50 ft and during the course of travel went as high as 30 ft in the air before it finally struck a building. Fortunately, no one was in the path of flight, says the National Safety Council *News Letter*, which reported this item.

* * *

Monthly Rental Available on Inert-Gas Stud Welding

THE Shielded Stud Welding Co., 124 West Fourth St., Los Angeles 13, has announced a new licensing agreement for its process of inert-gas stud welding. This process is claimed to make quality welds on aluminum, stainless and other metals including mild steel. To use the process, the customer pays a monthly charge for a patented adaptor necessary to the operation of the process.

Birmingham NWSA Meeting Attracts 40 Delegates

THE Bankhead Hotel in Birmingham, Ala., was the scene Dec. 4, of the southeastern zone meeting of the National Welding Supply Association. More than 60 distributors and manufacturers were present. W. A. Rice, zone vice-president, Virginia Welding Co., Charleston, West Va., presided over the get-together.

R. C. Fernley, NWSA secretary and R. S. McCracken, Jr., national president, outlined the activities and advantages of the association to the Birmingham meeting. A round table discussion followed concerning the effects of the defense program on welding distributors. Leslie P. Beaver, Jr., Beaver Welding Supply Co., Memphis, Tenn., gave his views on the proper ways to select, hire and train salesmen.

The lively association luncheon was topped off by a talk on "Taxes in your Shirt Tail." The speaker, J. D. P. Arnold, of F. Hopkingson Smith and Co., Birmingham, pointed out that there were 232 taxes on a shirt. Everyone present got a new slant on the tax situation (see THE WELDING ENGINEER, page 31, this issue).

After lunch, Ted B. Jefferson, editor of THE WELDING ENGINEER, Chicago, pinchhitted in a talk on the importance of keeping up on the new welding developments. Glenn Garman, Purity Cylinder Gases, Grand Rapids, Mich., past president of NWSA, was the second substitute speaker of the afternoon and led a discussion on how distributors can advance welding developments. An effective method of cylinder control and demurrage billing was presented by another pinchhitter, George Watkins, Welder Supply Co., Richmond, Va. J. L. Kirk, Bashlor-Sowers Welding Service, Inc., Bluefield, West Va., closed the program with an excellent talk on why his firm uses direct mail advertising.

Nine new members enrolled at this time include: Mid-South Oxygen Co., Memphis; L. S. Jullien, Inc., Washington, D. C., Welder Supply Co., Nashville, Tenn.; Jones Welding Supply, Roanoke, Va.; Lee Supply Co., Lynchburg, Va.; Glendale Optical Co., New York City; Downs Welding Equipment Co., Chattanooga; Williams Auto Parts, Decatur, Ala. and Standard Welders Supply, Memphis.

All present agreed that it was the most successful zone meeting for the southeast states that had yet been held. Every delegate returned to his welding business with new ideas on promotion, accounting and advertising.

PAGE *Stainless Steel*

WELDING ELECTRODES

Armor Welding Electrodes

. . . and All Standard Types

AC or DC . . . the BEST

. . . for any weld

on all types

of stainless steel

STAINLESS STEEL has great strength . . . but its strength is limited by the quality of welds which seal the joints. In all kinds of manufacturing—military work in particular—stainless is being used more widely. If you weld stainless, choose electrodes with care.

PAGE STAINLESS STEEL ELECTRODES, AC or DC, give a stable arc under all conditions. The metal flows smoothly. Slag is clean and easily removed. The coating resists cracking down to very short stubs. Now available in 10-lb. lined, hermetically sealed metal cans which can be reclosed. ***Be sure . . . specify Page Stainless Steel Electrodes.***

ACCO

Monessen, Pa., Atlanta, Chicago, Denver, Detroit, Los Angeles, New York, Philadelphia, Portland, San Francisco, Bridgeport, Conn.

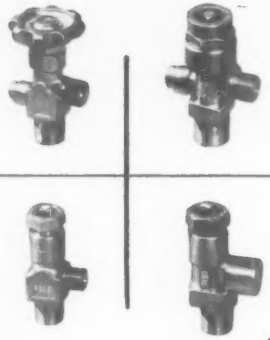
PAGE STEEL AND WIRE DIVISION
AMERICAN CHAIN & CABLE

PAGE WELDING ELECTRODES

REGO

HIGH PRESSURE

CYLINDER VALVES



FOR OXYGEN AND HYDROGEN
Designed, tested and proved for high pressures and severe service. Packing may be replaced with cylinder under pressure if necessary. Fuse plug and bursting disc provide positive safeguard. Bronze stem furnished as standard, also available with monel stem on special order.

FOR ACETYLENE
Cadmium-plated steel stem with monel tip resists rust and wear. Ball-nose seat construction assures positive shut-off.

FOR CARBON DIOXIDE
Available with diaphragm-type or packed-type construction. Compact rugged design for use with high pressures. Equipped with bursting disc safety device.

REGO

The BASTIAN-BLESSING Company
4201 West Peterson Ave. Chicago 30, Illinois

*Reg. U. S. Pat. Off.

PIONEER AND LEADER IN THE DESIGN AND MANUFACTURE OF PRECISION EQUIPMENT FOR USING AND CONTROLLING HIGH PRESSURE GASES

POINTING out uses of stud welding on boxcars is H. M. Eaton, Jr., railroad sales manager

Nelson Stud Welding Holds Coöperation Conference

GREATER understanding and a clearer perspective of its business was the goal planned by Nelson Stud Welding Division, Gregory Industries, Inc., for a recent meeting of its executives and its professional counselors (lawyers, auditors, insurance counsel, key suppliers, etc.). George E. Gregory, president of the Lorain, Ohio, firm, conceived the idea as a "professional service conference," to see if a small business could get the same broad, interested cooperation from its special advisors as the big corporation gets from its full-time experts.

The 23 participating conferees spent a full twelve-hour day discussing carefully planned factual statements. At first, some conferees doubted that anything useful could come from such a "merry-go-round." By the time the group broke up, however, several of the most outspoken skeptics had come up with ideas and stud welding applications that have kept Nelson engineers busy ever since.

Subjects discussed during the long and busy day included commercial and investment banking, auditing, tax consulting, production, equipment, review of research, development and patent activities, budgeting, control, reporting, customer relations, sales activities and insurance policies.

Executives, suppliers and counselors taking part included Mr. Gregory, W. J. Kane, vice-president and manager of construction sales; L. C. Barr, vice-president and general sales manager; Horace S. Maynard, secretary-treasurer; M. A. Enright, vice-president in charge of manufacturing and engineering; R. J. Kilmer, controller, and Gene P. Hopkins, general works manager; James F. Lincoln, president, The Lincoln Electric Co.; W. W.

Sinclaire, a Gregory Industries director and assistant secretary, Corning Glass Works, Corning, N. Y.; Paul E. Orr, Jr., executive vice-president, Management Planning of Wash., Inc., Princeton, N. J.; Dr. T. N. Beckman, Ohio State University; Carl A. Thompson, Hill & Knowlton, Inc., Washington; A. B. Loop, Shumaker, Loop, Kendrick & Winn, lawyers and A. M. Young, Sales Analysis Institute, Chicago.

* * *

Australians Publish Eye Safety Standards

A CODE of recommended practices has been published by the Standards Association of Australia for the protection of eyes against harmful radiations in welding and cutting operations. Standards are specified for the manufacture and testing of welding filter lens and cover lenses. Filters are classed in terms of shade numbers giving the visible transmission, ultra-violet transmission and infra-red transmission for each shade. Another specification covers satisfactory design and construction of goggles and other devices used to protect the eyes and person against radiation.

—McGraw-Hill World News

* * *

American Optical Wins Top Safety Council Award

THE Distinguished Service to Safety Award of the National Safety Council was recently presented to American Optical Co., Southbridge, Mass. The company's 4,000 employees at Southbridge worked 8,021,910 hours in 1950 with only five accidents and 44 lost days. This is the 11th safety prize won in the past six years by the company, manufacturers of industrial safety equipment as well as opthalmic and optical products.

"Put on this helmet and jacket! It's your big scene!"

MEETING MILITARY SPECS IS AN OLD STORY FOR T-W USERS

Specifications Mil-W-6860 and 6858 (formerly AN-W-30 and 32) and Taylor-Winfield resistance welding equipment have been partners for years. From Taylor-Winfield you can have the efficient Tri-Phase DC or Single Phase Spot and Seam AC welders in many sizes and styles. From Taylor-Winfield you can obtain all the engineering data or field assistance you need to meet your problem, and the welders to do the job. Let T-W know your requirements. Write, wire or phone.

RESISTANCE WELD

AIRCRAFT FRAMES
JET ENGINE PARTS

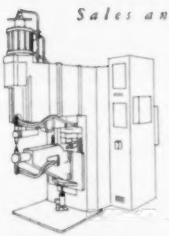
•

PROJECTILES
WEAPONS
CONTAINERS

•

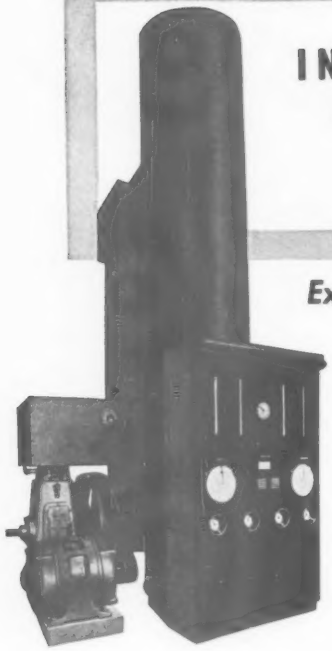
ALUMINUM ALLOYS
STAINLESS STEELS
NICKEL ALLOYS
LOW ALLOY STEELS
TITANIUM ALLOYS
LOW CARBON STEEL
ALLOYS OF MAGNESIUM, COPPER AND OTHER MATERIALS

THE TAYLOR-WINFIELD CORPORATION • WARREN, OHIO
Sales and Service In All Principal Cities



Resistance Welders Since 1883

TAYLOR-WINFIELD
RESISTANCE WELDERS



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GAS PRODUCING
PLANTS

Expansion Engine Type
Low Pressure
OXYGEN
AND
NITROGEN
Producing Plants

Built in standard sizes—15 meters or 530 cu. ft to 283 meters or 10,000 cu. ft.—in single and double rectification units. If you need them, larger sizes are available.

If the more than one quarter of a million INDEPENDENT CYLINDERS we have built were filled at one time, they would hold more than 50,000,000 cu. ft. of gas!

Furthermore, Independent Acetylene Cylinders hold from 5 to 10% more gas, and the uniformity of the monolithic filler insures even distribution of acetone. Oxygen Storage cylinders available in 12' and 20' lengths; capacities 850 and 1500 cu. ft.

10 C.F. 40 C.F. 60 C.F. 100 C.F. 150 C.F. 250 C.F. 300 C.F. 340 C.F.

WE INVITE YOUR INQUIRIES

INDEPENDENT ENGINEERING COMPANY, Inc.
Manufacturers of
CONSULTING RESEARCH DESIGNED
CYLINDERS AND GAS PRODUCING EQUIPMENT
ACETYLENE · OXYGEN · HYDROGEN · NITROGEN
O'FALLON 5, ILLINOIS

Canadians Oversubscribe Correspondence Welding Course

UNEXPECTED heavy demands for a correspondence welding course put out by the Canadian Welding Bureau have necessitated a new printing and commencement of a second course. The new course will start about the middle of January and continue for a year, including a summer holiday.

More than 1,000 engineers, supervisors, foremen, etc., took the correspondence course when it was first offered in 1950. It consists of a total of 17 lessons taking up more than 375 pages. In addition there are 75 pages of appendices dealing with the welding of aluminum, nickel and copper with their various alloys. Though last year's course was sent out a lesson at a time, this new one will be sent out in its entirety, for convenience as a reference or as a means for forward study. With each lesson is included an exercise that the student returns to the Bureau for checking and grading.

At the course's end, students may sit for a written examination which last year was given in 24 centers across the dominion. Successful students are granted a diploma.

Basic theory and fundamentals of good welding practice and design are the pillars of the course. It does not teach the student to weld, but attempts to acquaint the engineer, draftsman, supervisor, inspector and weldor with the principles of modern welding.

Anyone interested in the course may write to the Canadian Welding Bureau, 22 College St., Toronto, Ont.

* * *

General Electric Forms Six New Divisions

THE formation of six new operating divisions by General Electric has been announced. They are the turbine division and the motor and generator division, with headquarters at Schenectady; transformer and allied products division at Pittsfield, Mass.; measurements and industrial products division at Lynn, Mass.; switchgear and control division at Philadelphia and the component products division at Fort Wayne, Ind.

Glenn B. Warren is general manager of the turbine division. James M. Crawford is general manager of the motor and generator division. Francis E. Fiarman, Jr., has been named general manager of the transformer division. George E. Burens is the new general manager of the switchgear division. Harold E. Strang is general manager of the measurements and industrial products division. William C. Wichman is general manager of the component products division.

Manly Fleischmann Talks at Plant Maintenance Show

THE administrator of the Defense Production Administration, Manly Fleischmann, will head a group of 56 speakers at the Plant Maintenance Conference, Convention Hall, Philadelphia, Jan. 14-17. The conference will have as its general chairman, L. C. Morrow, consulting editor, *Factory Management & Maintenance.*

Besides numerous papers on the maintenance of equipment in metalworking plants, chemical producers, power plants, food processing plants, etc., there will be one specific paper on welding. Alfred A. Wald, superintendent of maintenance at Caterpillar Tractor Co., Peoria, Ill., will speak on welding in maintenance.

• • •

New Ultrasonic Gage Aids Ship Inspection

THINNING of a ship's plates by corrosion has always been a headache for shipowners. Not only does it ultimately mean the replacement of plates, it also presents a problem of finding out just how thin the plate has become. At times, it has been necessary to drill as many as 500 holes in a vessel when its age indicated such a corrosion condition.

Use of the "Audigage," an ultrasonic instrument for non-destructive determination of thickness, has been developed by Sam Tour & Co., New York City, to the point where it now is possible to completely eliminate such numerous drillings. Official marine surveyors who have examined ships checked by this gage did not even require check holes. Another use of the gage is in the determination of the thickness of metallized coatings on ships, bridges, flagpoles, etc.

• • •

Discuss Copper Welding in Australia Confab

CONSIDERABLE welding of copper plate in Australia resulted in the calling of a conference on the subject by the Standards Association of Australia. Invitations were sent to selected members from the committee on copper and its alloys, the boiler welding subcommittee and the railway rolling stock materials committee.

The conference recommended that Australian standard No. H.18 be withdrawn and that British standard 1172-4 be endorsed with minor amendment. It was also decided that Australian standards B.21 and E.8 be reviewed by appropriate committees with the objective of developing a single specification.

—McGraw-Hill World News

"COPPERHEAD" INSULATOR TIPS

OPERATE NEAR 6,000° HEAT

WAGNER

ELECTRODE HOLDERS

Heavy woven glass fabric pressure bonded with long asbestos fibre provides: (1) enormous resistance to arc heat; (2) excellent electrical insulation; (3) high impact strength. Most practical insulator tip ever built.

● "WAGNERLOY" BOOSTS CONDUCTIVITY

Full butt-to-jaw current is insured in WAGNER electrode holders through exclusive "WAGNERLOY" construction. This special copper alloy imparts extraordinary tensile strength and increases resistance of electrode holder to welding arc heat. Weld-at-any-angle design includes ball and socket swivel joint. Tremendous gripping pressure developed by compound cam and lever system. Chrome Vanadium steel springs permit tension to be adjusted within less than a minute.

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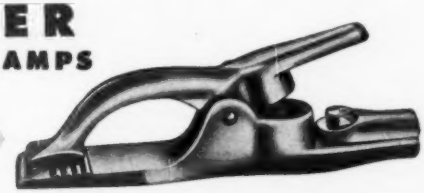
WAGNER

GROUND CLAMPS



DIG UNDER FLAT WORK—SERVE AS PLATE

Beveled lower tong of broad flat base slips underneath and securely grounds flat work. May be used as clamp or plate. Powerful chrome vanadium steel springs easily adjustable. Fully shielded. Immediate delivery possible on heavy—general—and light duty clamps.

Your Dealer Will Be Glad To Demonstrate.

WAGNER MANUFACTURING CO.

250 W. 1st SOUTH ST. JACKSON, MISSOURI

Robotron EXPANDS AGAIN...TO MEET INDUSTRY'S EVER-GROWING DEMANDS!

From a simple 3B Weld Timer in 1948 to a complete line of **Synchronous and Non-Synchronous Electronic Welding and machinery controls** in 1951 . . . Robotron has tried to grow *with* industrial needs. To succeed these controls had to help increase productivity, quality control and general operating efficiency. These controls had to be created, tested and proven *before* they were accepted. It was features like: Quick interchangeable control panels, simplified circuits, husky industrial designs, unit construction (for easy accessibility), compactness, dependable performance and a minimum of maintenance that put **Robotron Electronic Controls** across. And repeat orders from all major industrial plants proves these features are more popular than ever.

The new, large, modern plant shown above, is our third expansion within 3½ years. More evidence that Robotron *is* meeting industry's growing demands. This building and the investment it will represent in equipment and the time of men of specialized skills—is a symbol of our faith in the future of our company, our industry and our country.

Let Robotron show you how better control of your industrial production energy will result in *more and better products at less cost!* No obligation of course.

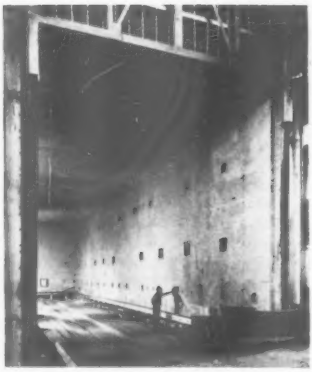
FREE! Ask for NEW Robotron "Catalog of Non Synchronous Timers" and "Why Robotron" booklet.

THE FINEST IN INDUSTRIAL ELECTRONICS

Robotron* CORP.

21300 W. Eight Mile Rd., Detroit 19, Mich.

2397 *T. M. Registered



TREMENDOUS stress relieving furnace handles huge weldments

Welded Refinery Towers Handled by Giant Furnace

AMONG the largest of its kind in North America is a new stress-relieving furnace recently installed at the Lachine, Que., plant of Dominion Bridge Co. It is 85 ft long, 18 ft high and 18 ft wide and will permit the sectional stress relief of refinery towers and Class 1 pressure vessels up to the largest sizes.

Weldments to be stress relieved are carried into the furnace on a 300-ton capacity railroad car that has been specially constructed for this work.

The furnace is oil-fired and the temperature recorded by a 16-point pyrometer. The door is made from a steel frame instead of the usual cast iron. Both furnace and door are insulated by new lightweight refractory bricks.

* * *

Welding Fellowships Available at Rensselaer

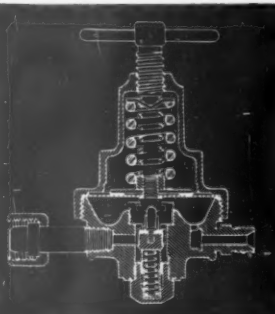
Two fellowships in metallurgy, each with an annual value of $3,500 are available at Rensselaer Polytechnic Institute, Troy, N. Y., for graduate students who wish to pursue advanced work in seam and spot welding. The fellowships have been established by the Welding Research Council, New York City and are to be awarded through Dr. Ernest F. Nippes, director of welding research at the school.

* * *

First Oxygen Plant for Anchorage, Alaska

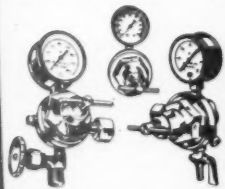
THE Alaska Chemical Co., Fairbanks, Alaska, has purchased a site for a second plant at Anchorage. The 50 by 150 ft plant should be in operation by May, according to W. C. Buckow, general manager and president. It will be the first oxygen and acetylene plant in the town.

DEPEND ON DURABLE DOCKSON REGULATORS



in types for Oxygen, Acetylene, CO_2, Air, Fuel Gases.

"BUILT FOR BETTER SERVICE" with improved diaphragms, replaceable; self-aligning seats; sturdier construction; shatter-safe gauges; alert safety valves and other advantages.



THERE IS A DOCKSON DISTRIBUTOR NEAR YOU—Let us send you his name and our complete catalog of DOCKSON WELDING and CUTTING EQUIPMENT.

Dockson CORPORATION
3839 WABASH • DETROIT 8, MICH.

Welded Bridge Contest Offers $16,100 in Prizes

To encourage more instances of the 5 to 20% savings in steel accruing from welded bridge designs, The Lincoln Arc Welding Foundation will offer $16,100 in prizes to winners of its 1952 award program, "Welded Bridges for Steel Conservation."

Open to anyone in the United States feeling himself qualified to enter, the program offers 15 awards for the best welded bridge designs. Complete freedom as to size and type of bridge will be allowed since the percentage of steel saved over a similar riveted bridge will be the most important factor in judging.

Rules for the program have been formulated by 14 of the nation's top bridge engineers. First award is $7,000, second is $3,500, third is $2,000 with 12 honorable mention awards of $300 each.

Complete rules for the award program are available from the James F. Lincoln Arc Welding Foundation, Cleveland 17, O.

* * *

Caterpillar Tractor Builds New York, Pa., Plant

AN expansion program that will include a new factory in York, Pa., additions to the Joliet, Ill., plant and some improvement in the Peoria, Ill., plant has been announced by Caterpillar Tractor Co.

The York plant will be erected on a 180-acre site and will cover 360,000 sq ft of floor area. About 1,000 people will be employed there.

Major additions to the Joliet plant will be a 230,000 sq ft extension to the present manufacturing building, a separate parts building covering 280,000 sq ft and an addition to the heating plant. About 1,000 more employees will be needed upon completion of the new additions.

* * *

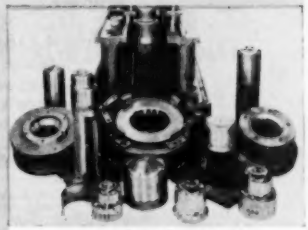
G-E Theme at Show to Be "Productive Maintenance"

GENERAL ELECTRIC COMPANY'S "Productive Maintenance" plan will be the theme at the G-E exhibits at the Third Plant Maintenance Show in Convention Hall, Philadelphia, Jan. 14-17.

The company will show a total of 25 individual displays covering 2,200 square feet of floor space. They will include welding equipment, renewal parts; motors, generators, special products, rectifiers, switchgear, meters and measuring equipment.

Included in the men scheduled to meet visitors in the exhibit will be C. L. Helms of the G-E Welding Department.

300% more life from dies



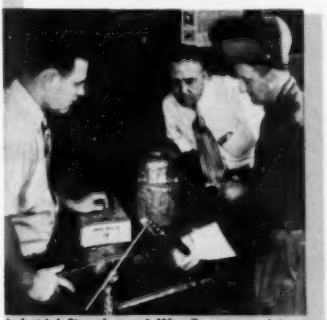
overlaid with Ampco Bronze Electrodes

Production was increased from 3600 deep-drawn cases (for sealed refrigeration units) to 15,000 cases, when Industrial Stamping and Manufacturing Co. of Detroit overlaid their steel punches and die-rings with Ampco Bronze electrodes.

Big Savings in Press Room

Downtime was greatly reduced and operating time increased. Efficiency was upped 15% because presses did not have to be stopped to hone and polish dies or change tools in the middle of a run. Average production was increased to 15,000 units before appreciable signs of wear on the dies.

Put Ampco Bronze electrodes to work for you. Enjoy longer production runs, less downtime, lower costs.



Industrial Stamping and Mfg. Co. personnel inspecting punch overlaid with Ampco Bronze electrodes.

W-212

AMPCO Ampco Metal, Inc.
Milwaukee 46, Wis.
It's Production-Wise to Ampco-ize!

ACCURATE PRECISION WELDING

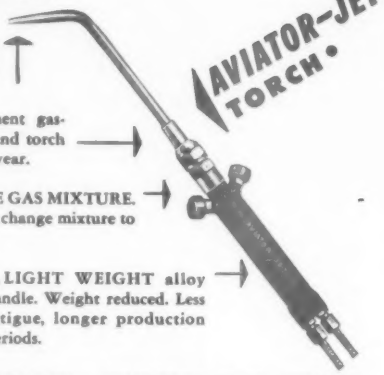
MADE EASY...

1. PERMANENT ACCURACY OF FLAME. Assured by spring tension control valves.

2. Armored attachment gasket between mixer and torch handle. Minimizes wear.

3. PRECISE GAS MIXTURE. No need to change mixture to fit tip size.

4. LIGHT WEIGHT alloy handle. Weight reduced. Less fatigue, longer production periods.



RUGGED • LIGHT • EASY TO USE

Here's the perfect double duty torch wherever sheet metal is welded. Uses either oxygen, acetylene, or oxygen and hydrogen. Designed for automobile body shops, refrigeration servicemen, electric manufacturers, and other sheet metal welders.

Ask your dealer to show you the AVIATOR-JET Cutting Attachment too! Cuts up to one inch.

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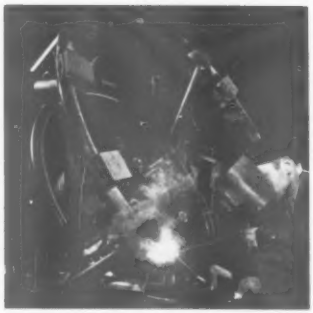
Protect your eyes with MODERN ALL-PLASTIC

Eye-Savers give you comfortable fit, good-looking construction and *sure* eye protection—all at the same time! One-piece flash goggle 10G3 provides complete safety for under-helmet use and other glare and impact hazards. Shatterproof plastic lens is green tinted, optically clear, and may be replaced. Fits over most style glasses and permits comfortable, wide angle vision. Order from your welding (or safety) supplier or write direct.

FREE! *Send for magazine article giving impartial advice on best uses of plastic eye protection. Eye-Savers catalog also included.*

WATCHEMOKET OPTICAL CO., INC. DEPT. 5, PROVIDENCE, R. I.

Producers & Originators of Practical Plastic Eye Protection



RECONDITIONING a World War II aircraft engine mount for use during future production of B-36 engines at Ford Motor Co.'s huge Chicago plant

Airless Abrasive Blasting Increases Tote Box Life

CATERPILLAR Tractor Co., Peoria, Ill., has begun a program for reconditioning tote boxes in an "airless blast" cabinet. Chipped paint and accumulated rust are quickly removed by the abrasive thrown from two rotating wheels. Each box requires 2 minutes of blasting time.

Caterpillar has approximately 187,000 tote boxes to put through the reconditioning program. Each box will go through reconditioning every 2½ years, and it is expected that the normal lives of the boxes will be doubled. The blasting cabinet was designed by the American Wheelabrator & Equipment Corp., Mishawaka, Ind.

• • •

Pittsburgh Man Wins Sellstrom Birthday Prize

C. H. SEIPP of The C. H. Seipp Rubber and Equipment Co., Pittsburgh, a Sellstrom Company dealer, won the handsome Stiffel floor lamp in the Sellstrom birthday drawing for November. Meyer Friedman of The Triangle Supply Co., Chicago, drew Mr. Seipp's name. One Sellstrom dealer is selected each month to win the prize, only condition being that the drawing is held by a dealer whose birthday is that month.

• • •

Eutectic Expands Research Laboratories

COMPLETION of a new wing to house two new research laboratories has been revealed by Eutectic Welding Alloys Corp., Flushing, N. Y. Research on the welding of alloys containing fewer critical metals and on titanium will be carried on in the new building by a special staff of chemists and physicists.

NWSA Southwestern Meeting at Dallas, Dec. 7

SOME 83 manufacturers and distributors of welding equipment met at the Hotel Adolphus, Dallas, Tex., Dec. 7 for the annual southwestern zone meeting of the National Welding Supply Association. C. O. Stillwell, zone vice-president, Gulf Welding Supply Co., New Orleans, was in charge of the gathering.

Following the customary NWSA meeting pattern, R. C. Fernley, NWSA secretary, opened the meeting with a review of association activities. National president R. S. McCracken, Jr., then addressed the meeting on the subject, "NWSA and You."

First speaker on the zone problems of welding supply distribution was R. G. Harrison, Welders Supply Co., Little Rock, Ark., who discussed the steps his firm takes in selecting, hiring and training salesmen. J. S. Lowrey, Alamo Welding Supply Co., San Antonio, Tex., then talked on ways and means by which the welding distributor can aid in the general advancement of welding methods.

A spellbinding talk on management was given after lunch by W. A. Beutel, general manager, Mosher Steel Co., Dallas. He pointed out how many present day mixups could be attributed to our inability to manage.

Paul E. Haygood, Louisiana Welding Supply Co., Baton Rouge, La., illustrated his talk on the importance of layout and display techniques with many pictures. Advantages and disadvantages of direct mail advertising were compared by O. W. Edwards, vice-president and general manager, Welders Supply Co., Inc., New Iberia, La. The closing formal paper of the session was by Charles E. Squibb, Welders Supply, Inc., Dallas, and was a reminder of the importance of keeping abreast of new product lines.

After the papers were presented, a round table discussion led by Chairman Stillwell brought out the possible economies in the operation of a modern welding supply business.

Five new members were taken in at the Dallas meeting. They are: Hughes Welding Co., Shreveport, La.; H & M Pipe Beveling Machine Co., Tulsa, Okla.; Valley Welders Supply Co., Albuquerque, N. M.; Peerless Supply Co., Shreveport, and M & M Supply Co., Abilene, Tex.

* * *

Jefferson to Speak

T. B. Jefferson, editor of THE WELDING ENGINEER, will be the guest speaker at the joint meeting of the St. Louis sections of AWS and American Society of Tool Engineers, Jan. 3, at the Engineers club of St. Louis.

Tippy Says: GOOD QUEEN BESS YOU CAN BET.. WORE A WELDED CORSELET!

Tippy Says: . . . Take a tip, try TIPALOY!

And How! . . . Bess was a pretty smooth job in that torture rack.

Today with the help of TIPALOY Resistance Welding Electrodes you will have smoother, stronger jobs, with less trouble . . . redressing and mushrooming are cut to a minimum . . . and you receive extraordinary service under heavy production stresses . . . investigate TIPALOY Resistance Welding Electrodes Now!

Write today for test samples and "the story of STRAIGHT LINE conductivity!"

Tipaloy INC. 1435 EAST MILWAUKEE DETROIT 11, MICHIGAN

No. 8 of a Series — Branches in All Principal Cities

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THIS WIRE FORMED AND FLATTENED INTO THIS WASHER WITHOUT WASTE

COINED WIRE WASHERS Cut Unit Costs by Eliminating Waste in SILVER BRAZING

NO DIE CHARGES

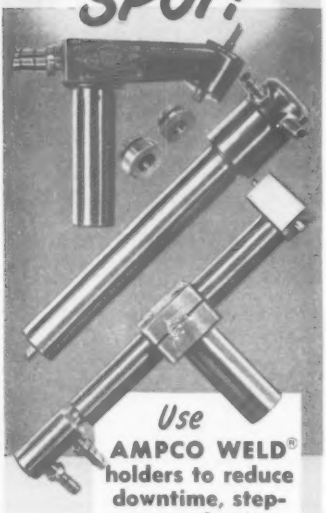
You save up to 50% because the high cost of scrap in blanking out of sheets is entirely eliminated. Available in EASY-FLO and SIL-FOS.

Send specifications for free samples.

LUCAS-MILHAUPT ENGINEERING COMPANY

5057 S. Lake Drive · Cudahy, Wisconsin

Put resistance welding costs on the SPOT!



Use **AMPCO WELD® holders to reduce downtime, step-up production**

There's an AMPCO WELD® holder for every resistance-welding job — offset ejector holders, straight ejector holders, universal ejector holders. All are leak-proof. Made of high-conductivity Ampco Bronze alloys, they meet or exceed RWMA specifications to give you trouble-free operation, longer runs, reduced downtime, and increased output.

. . . AMPCO* Engineering Service when you need it

Behind the famous AMPCO WELD® line of resistance-welding products is a corps of experienced engineers, ready to help you solve your problems. Just get in touch with us.

AMPCO METAL, INC.

AMPCO MILWAUKEE 46 WISCONSIN

RW-3

West Coast Plant, Burbank, California

It's production-wise to Ampco-ize!

*Reg. U. S. Pat. Off., Ampco Metal, Inc., Milwaukee

About People

C. BURNELL ABEL has been appointed vice-president in charge of sales of the Miller Electric Manufacturing Co., Appleton, Wis., N. C. Miller, president of the company, announced at a recent conference of district sales managers. Formerly the sales manager, Mr. Abel has been actively identified with selling in the welding industry for the past 17 years.

* * *

L. E. OSBORNE has been named executive vice president in charge of defense products at Westinghouse Electric Corp. TOM TURNER assumes the new title of vice president in charge of manufacturing and labor relations, retains his post of vice president in charge of labor relations and also takes over former duties of Mr. Osborne. W. B. ANDERSON has been appointed assistant to Mr. Osborne. FRANK L. SNYDER replaces Mr. Anderson as manager of the Aviation Gas Turbine Div. R. C. BERGVALL has been appointed manager of engineering in defense products. B. M. BROWN is the new sales manager in defense products. M. A. DOTTERER has been named manager of production of defense products.

* * *

WILLIAM R. MEIKLE, who recently joined the National Radiator Co. of Johnstown, Pa., has been named plant manager of the Middletown, Pa. plant which produces steel heating boilers for residences, stores, institutions and industries. Mr. Meikle was formerly a production manager for Burnham Corp., Irvington, N. Y., and is also a member of ASME.

* * *

ROBERT W. CAMPBELL, senior metallurgical engineer at the Sylvania Electric Products, Inc., Bayside, N. Y. plant, was the winner of the chronograph presented at the Nelson Stud Welding exhibit at the Metal Show in Detroit for the best estimate of the time required to stud weld 198 studs to a section of tubing. Mr. Campbell's guess of 60 minutes, 45 seconds, was the closest of more than 4,000 submitted.

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150	300	550	1100	1650
163	313	600	1150	1700
175	325	650	1200	1750
188	338	700	1250	1800
200	350	750	1300	1850
213	363	800	1350	1900
225	375	850	1400	1950
238	388	900	1450	2000

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New York 11, N. Y.

E. B. BROWN has been appointed assistant sales manager of the Detroit branch of American Brass Co. to contact automotive users of company products. Mr. Brown is the immediate past president of the Detroit section of the American Welding Society, and well known in welding circles throughout the country. He has been a development engineer at American Brass for a number of years.

* * *

J. L. ROBINSON has been appointed New England manager of the Gasflux Co., Mansfield, Ohio. He was formerly connected with Harris Calorific Sales Co., New York City.

* * *

R. A. METCALF has been appointed sales manager of the Miller Electric Manufacturing Co., Appleton, Wisconsin. He was formerly the assistant sales manager and has been associated with the welding industry for the past 14 years in various sales capacities.

* * *

SAMUEL P. OWEN has been appointed advertising manager of the Rockwell Tools, Inc., Columbus, O. This firm was recently acquired by the Rockwell Mfg. Co. to augment its Delta Power Tool Division.

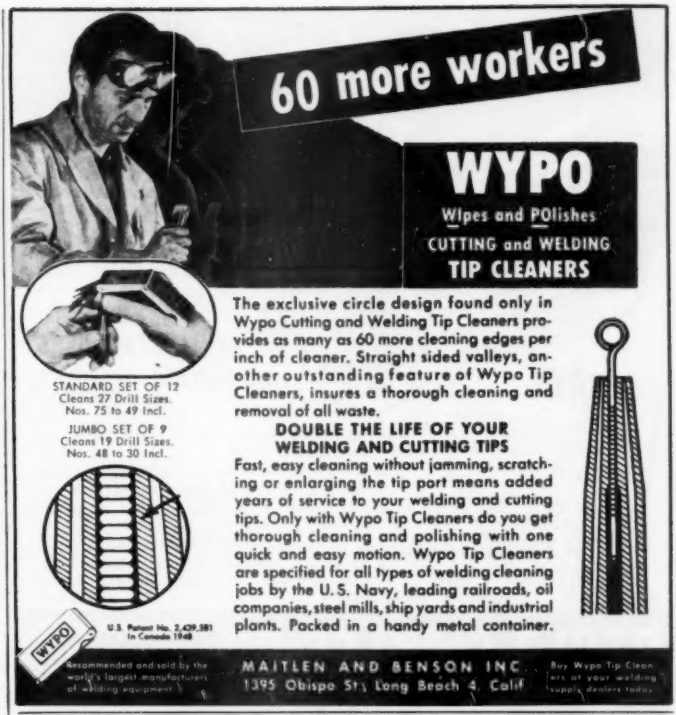
* * *

HOWARD LONG has been appointed welding products engineer for the Northwest states, announces the Apparatus Division of the General Electric Co. Mr. Long conducted the Pacific Welding Institute at Seattle, Wash., in 1940-41. He will be responsible for welding sales in Washington, Oregon and parts of Idaho and Montana.

* * *

Died . . .

RAYMOND CHARLES FORCE, first president of Caterpillar Tractor Co. and member of the board of directors, passed away Nov. 15 in Oakland, Calif., at the age of 71. He served as the company's president from its founding in 1925 till 1930, then became chairman of its executive committee and took on other duties. Mr. Force became associated with the track-type tractor business in 1919, when he was named vice president and secretary-treasurer of the C. L. Best Tractor Co., one of Caterpillar's two predecessor companies. He is survived by his wife, 2 sons and a daughter.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STANDARD SET OF 12
Cleans 27 Drill Sizes.
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JUMBO SET OF 9
Cleans 19 Drill Sizes.
Nos. 48 to 30 Incl.
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In Canada 1948
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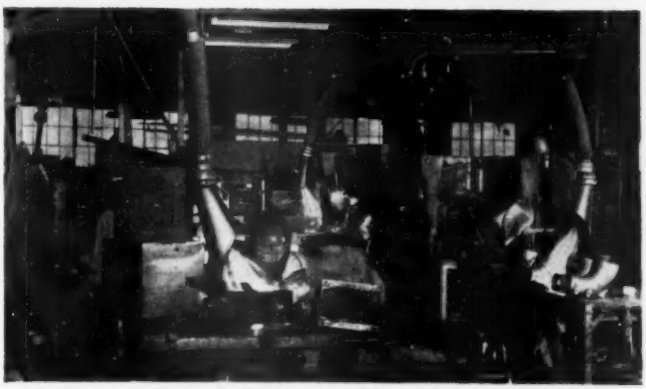

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This well ventilated welding department is typical of hundreds of similar installations. Welding operators appreciate smoke and gas-free atmosphere. Thousands in service. Many repeat orders. Collecting fumes at the source with local exhaust hoods has proven most practical in operation. It is particularly helpful in winter months when doors and windows are closed. Write for Bulletin 37-D describing all types of Ruemelin Fume Collectors.

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Book Reviews

Everything about Welding

THE WELDING ENCYCLOPEDIA, 13th Edition. Edited by T. B. Jefferson. Published by McGraw-Hill Book Company, New York City, 1951. Simulated leather, 6x9 in.. 1,008 pages. Price $7.50.

Practicability is the outstanding characteristic of *The Welding Encyclopedia*. The new 13th edition is a volume that should be on the desk of every shop man, engineer and designer who are interested in welding in any way, shape or form.

The Welding Encyclopedia, the oldest reference book on welding, shows the progress that welding has made over the past thirty years. When the first edition was published, welding was used primarily for maintenance work but now it has grown to become a major fabrication means wherever metals are joined. Originally published in 1921, *The Welding Encyclopedia* has come through successive editions until more than 200,000 copies have been distributed throughout the United States and all over the world.

The new 13th edition of *The Welding Encyclopedia* has been completely revised to bring the reader up-to-date on welding developments. It has been the aim of the editor to treat every subject which deals in any way with welding, cutting or related processes. In the revision, it was necessary to replace over one hundred pages of the material of the previous edition to take care of advances which have been made in welding in the past three years. Despite the deletion of obsolete material, the text has been expanded by twenty-four pages over the previous edition.

As in the past, *The Welding Encyclopedia* is arranged alphabetically like a dictionary so that subjects may be easily located. The 1,008-page volume is really five books in one. The first section, over 800 pages, is a concise encyclopedia of welding. It is followed by an appendix of 32 pages to present helpful tables and charts, including those dealing with material specifications, examples of good and bad welds, temperature conversion tables, electrode specifications (covering steel and copper arc electrodes, as well as resistance-welding electrodes) and drill-size comparison data for both welding and cutting tips.

Part three of *The Welding Encyclopedia* lists all welding trade names alphabetically, gives the products to which they apply and the name of the manufacturer of the

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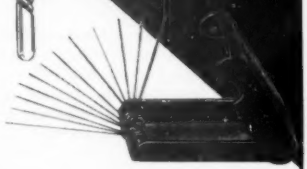

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product.' The dictionary of trade names is followed by a buyer's manual, which is the key to the source of many items of useful equipment used in the welding field. The Encyclopedia closes with a 14-page index, which provides extensive cross references to make complete coverage of any welding subject possible.

Many subjects which have come into prominence over the past few years have been dealt with extensively in the new edition. While some of these are still too new for many details to be available, other subjects such as bronze-facing, inert-gas-shielded arc welding, low melting fusion welding, die welding, tool welding, etc., have been discussed in a thorough manner.

The 13th edition will prove to be an invaluable aid to the engineer or designer interested in welding and welding problems. Likewise, the manner of material presentation makes the volume well suited for a text or reference book for school use or home study.

* * *

Machines

MANUFACTURING EQUIPMENT AND PROCESSES, Third Edition. By C. W. Lytle and A. F. Gould. Published by International Text Book Co., Scranton, Pa., 1951. Cloth, 6x9 in., 770 pages. Price $6.50.

The 14 years since the previous edition of this book have seen so many advances in manufacturing equipment and processes that this edition is practically a new work. In their rewrite job, the authors have attempted to clarify the technicalities of the most basic equipment and processes now used in the engineering shops in this country. Emphasis here is on the principles that should be understood before attempting either the selection or operation of such equipment.

The book that emerges is a combination of mechanical engineering principles and engineering economics. By revealing the technical potentialities of certain machines and processes, the suitability of each machine type becomes more understandable. Mysteries that sometimes obscure the merits of one over another are dispelled. To explain the possibilities of automatic operation, simple units are brought together. This is also done with coordinated transfer to reduce very complex machines to readily grasped terms. Incidentally, the evolution of each device is traced by historical footnotes.

Welding processes are covered in two chapters totaling 62 pages. One chapter discusses soldering, brazing

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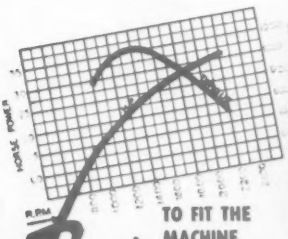

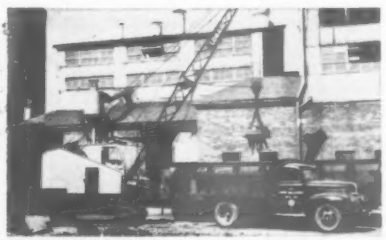

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Three carloads of scrap travel fast from freight cars to trucks every day with this crane on the job. It's equipped with a 36" ECM magnet, and the generator, built by Power Plants, Inc., Cleveland, Ohio, is powered by a Wisconsin Air-Cooled Engine.

Over and above time and labor saved through Wisconsin Engine dependability, servicing and maintenance are reduced to a minimum. For example, bearing failure is unheard of due to tapered roller bearings at both ends of crankshaft. Fool-proof air-cooling means no winter freeze-ups or summer overheating. And an easily-serviced OUTSIDE magneto with impulse coupling delivers all-weather quick starts. These features, combined with rugged construction, are the basis for the most dependable, most versatile power in the 3 to 30 hp. range . . . WISCONSIN POWER.

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and the welding of plastics, while the other covers the fusion welding of metals. Material in the latter chapter discusses thermit, arc, carbon arc, submerged-arc, inert-gas-shielded arc, automatic metal arc, atomic hydrogen and gas welding applications. Though welding discussions are brief, the book is a better text for their inclusion. Engineers and executives will find *Manufacturing Equipment and Processes* a valuable reference book that will help them to select machines that not only are well suited to given working conditions but are also economically sound investments.

* * *

Metallizing

METALLIZING HANDBOOK. Published by Metallizing Engineering Co., Inc., Long Island City, N. Y., 1951. Cloth bound, 250 pages. Price $3.

This handbook is a completely new work that is profusely illustrated with photos, diagrams and charts. It provides a comprehensive coverage of the technical and practical aspects of the process.

Various methods of surface preparation and the application of metallized coatings for machine element work, for corrosion protection and for special production jobs are described along with handy supplementary information.

Applications covered include such miscellaneous examples as the repair of blow-holes in castings, mass coatings in tumbling barrels, model work, glass and ceramics.

According to the publisher, the handbook represents 20 years' experience in the design, manufacture and use of metallizing equipment.

* * *

Resistance Welding

RESISTANCE WELDING DATA BOOK, Fourth Edition. Published by P. R. Mallory & Co., Inc., Indianapolis, Ind., 1952. Cloth bound, 500 pages. Price $3.

This completely rewritten and revised book is the first new edition in seven years and contains many new ideas on every phase of resistance welding. Adding to the completeness of the text are numerous photos, charts, tables and diagrams. More than 1,000 illustrations are included.

There are separate chapters on resistance welding fundamentals, spot welding, projection welding, seam, flash and upset butt, butt-seam welding, metals to be welded, alloys to be welded, electrodes, die holders, recommended practices, standard testing methods and resistance welds.

Copies are available at Mallory's Welding Division, Indianapolis 6, Ind.

30 YEARS AGO

From THE WELDING ENGINEER of Jan., 1922)

ELMER H. SMITH, president of Smith's Inventions, Inc., and the Commercial Gas Co., Minneapolis, is featured in this month's *Who's Who* in the welding industry. He relates how as a young man he studied electrical engineering at the University of Minnesota, until the day his food money ran out. A friend suggested the promising business of charging auto lighting cylinders with acetylene. Though this endeavor didn't turn much of a profit, it did get him into the acetylene producing and oxyacetylene welding business. Today he is one of the best known men in the welding industry.

— 30 YEARS AGO —

REFABRICATING structural steel with a welding torch is the special achievement of the Bonner Everett Co., Laurel, Miss. The company recently commenced erection of a steel frame turpentine still in a heavily forested area. When it came time to put the steel in place it was found that most of it was the wrong length or out of shape. Because of the delay and expense in getting the steel out of the area, it was decided to use an oxyacetylene torch to cut over-lengths, to weld extensions on short pieces, cut holes for rivets and to heat twisted shapes for realignment. Use of this torch may prophesy a day when the process will be employed extensively in the erection of structural steel.

— 30 YEARS AGO —

CAST IRON melting pots worth more than $30,000 were salvaged by oxyacetylene welding recently at Kellogg, Idaho. Some 26 of the 8-ton pots were all badly cracked in service at the smelter and looked ready for the scrap heap. An Oxweld Acetylene Company welding engineer didn't think so, however, and showed smelter officials how to salvage the lot. It took some experimenting, though, especially in the matter of preheat. For instance, in an improvised charcoal furnace, 26 sacks of charcoal hardly warmed the pot. It was necessary to supplement the charcoal with a compressed air and oil flame to get the necessary preheat temperature.

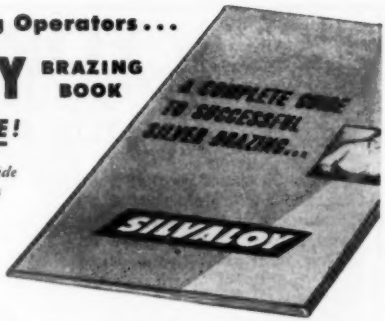
— 30 YEARS AGO —

THE Cleveland section of the American Welding Society announces a series of meetings for instructing job shop weldors. Royal D. Mahn, section chairman, will teach the classes at the Cleveland YMCA.

Engineers and Brazing Operators . . .

THIS SILVALOY BRAZING BOOK IS YOURS FREE!

Just published, "A Complete Guide to Successful Silver Brazing" is fully illustrated and easy to read!



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- Silver Brazing Fluxes
- Base Metals, Problems Related to Silver Brazing
- Silvaloy Selection Chart
- Joint Design
- Advantages of Silvaloy "Preforms"
- Preparation for Brazing
- Brazing Methods
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HERE AT LAST is the book you need to improve your brazing operations! There's a wealth of practical tips, technical material and data—all aimed at helping you get the most out of your low temperature brazing. Over 40 pages of completely reliable, accurate information...based on experience in supplying silver brazing alloys. Send for your free copy of the Silvaloy Brazing Book today.

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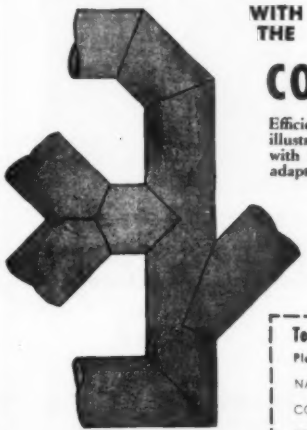

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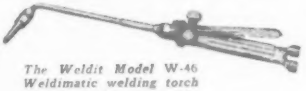

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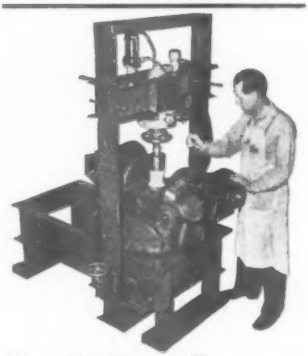
NEW PRODUCTS

(Continued from page 62)



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NEW standard line of hydraulic presses with movable frames provides the medium-size shop with means to bend or straighten large or awkward parts that must be moved by overhead cranes. The press has a large table, on to which the work is lowered. The frame is then moved over the table.

The workhead can be moved from side to side along the frame channel, making it easy to center the workhead above the work laterally as well as longitudinally. The workhead can also be moved up and down.

Presses come in 25, 50, 75 and 125 ton capacities. They can be furnished for either electric or air-powered hydraulic operation.

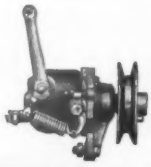
DAKE ENGINE CO., Grand Haven, Mich.

* * *

Spot Welding Goggle

Lightweight plastic goggle affords wide-angle vision and can be worn over prescription glasses. It is made in one-piece and has a molding rubber binding to fit the natural contours of the face. An elastic head band holds it to the head. The GS No. 100 goggle is clear plastic. GS No. 200 is green tinted plastic.

GENERAL SCIENTIFIC EQUIPMENT Co., 2700 West Huntingdon St., Philadelphia 32.



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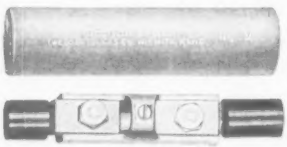

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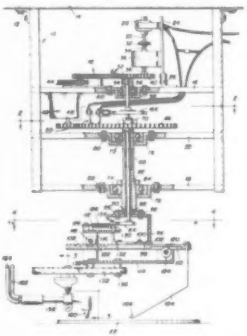
From the Patent Office

Flame-Cutting Gears

2,573,654. DANIEL A. SCHROCK, Boise, Idaho. Assigned to Idaho Sprocket and Machine Works, Boise, Idaho. Filed May 4, 1949. Granted Oct. 30, 1951.



This patent refers to an apparatus for forming a sprocket gear from a flat gear blank with the aid of an oxy-acetylene cutting torch. The flat gear blank is mounted below the torch in a cutting position. Means are provided for giving orbital movement to the cutting torch about an axis of rotation. There are also means for giving the torch radial movement from the axis of rotation in synchronization with the orbital movement. There are means for increasing the linear speed of travel of the torch over those parts of the blank where the path of travel of the torch has a smaller radius of curvature. For moving the torch there is a small electric motor and power source. The motor circuit includes a resistance controlled by a switch. It is mounted on the mechanism for giving orbital movement to the torch. The switch has a fixed member and a movable arm with complementary switch contacts on it. Cam-actuated means are fixedly mounted on the movable arm for closing the switch contacts to remove the resistance from the motor circuit. The cam for actuating the latter means is mounted on the mechanism for giving radial movement to the torch.

• • •

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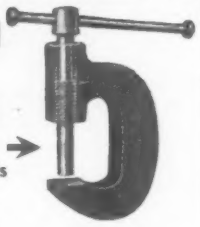

1. Case Hardened threads are always protected from weld spatter and never exposed to damage in open or closed position.
2. The clamp body is cut from solid plate, thereby insuring extreme rigidity and giving great resistance to bending or twisting.
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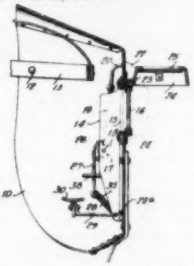
Weldor's Helmet

2,569,715. HOWARD H. GREEN, Bardwell, Tex. Filed April 25, 1949. Granted Oct. 2, 1951.

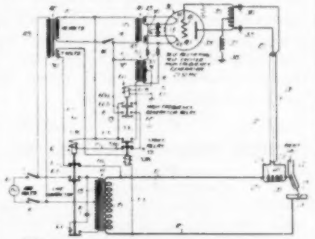


A newly patented weldor's helmet has a sight opening and a window hinged to overlie the opening. A rotatable cam mounted on a crank has diametrically opposed shoulders on its periphery. An arm with its upper end formed into a hook is adapted for alternate engagement with the shoulders to rotate the cam. A link connects the crank and the window to open and close the latter at each half revolution of the cam. A spring resists rotation of the cam to hold the window in open and closed positions. A linkage operated by the weldor's chin reciprocates the arm to actuate the cam.

* * *

Arc Welding System

2,573,901. DEAN C. GIRARD, San Leandro, and FRANK T. ROACH, Hayward, Calif. Assigned by mesne assignments to National Cylinder Gas Co. Filed March 7, 1950. Granted Nov. 6, 1951.



This patent refers to a system for controlling the energization of an intermittently loaded power circuit and includes a transformer with a primary and a secondary. A line contactor connects the primary to the alternating current source. A first relay energized from a separate current source is in series with the power circuit when it is short circuited and the line contactor is open. A second relay is energized as a result of the energization of the first relay and is arranged on removal of the short circuit and de-energization of the first relay to energize the line contactor.

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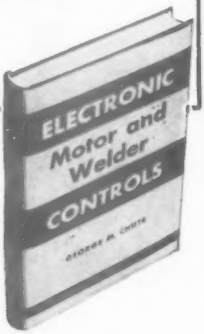

This is just one of the many enthusiastic comments on this step-by-step guidebook, that provides the means for quicker and better job performance for every man who selects, installs, or services electronic controls. It describes each important control device in use today—tells what circuits make it up and how each circuit operates.

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BY GEORGE M. CHUTE

General Electric Company

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Flame-Contouring Ends of Pipe

2,561,603. IRVIN A. WOERNER, Fort Collins, Colo. Filed Oct. 6, 1947. Granted July 24, 1951.

Patent refers to a machine for flame-cutting and contouring the ends of pipes. It comprises a supporting frame having spaced ends with bearings mounted in them. A tubular chuck is mounted in the bearings for centering a pipe. A ring gear surrounds the chuck. A drive shaft is mounted for rotation on the frame. The shaft has a pinion that operates with the ring gear. The drive shaft comprises two aligned sections interconnected by a shaft coupling. Hand-operated means render the shaft coupling inoperative. Hand operated means are provided for turning the part of the drive shaft having the pinion, so that the chuck can be rotated. A countershaft is mounted on the frame for rotation about an axis positioned above the center of the cylindrical member. There are means for rotating the countershaft at a speed directly proportional to the angular speed of the pipe. A spur gear is mounted on the countershaft for free rotation. A clutch mechanism is carried by the countershaft for frictionally securing the spur gear to the shaft for joint rotation. A rack is in operative engagement with the spur gear for movement transversely of the countershaft axis. A template is carried by the rack. A plate is connected with the ends of the frame for sliding movement in a line parallel with the axis of the chuck. A cam follower extends downwardly from the plate in position to engage the cam edge of the template. The plate is controlled in its axial movements by the template. A cutting torch carried by the plate is positioned above the pipe in a diametrical plane.

* * *

High Frequency Welding of Plastic

2,569,968. EDWARD GEORGE AUTIE and FREDERICK WILLIAM JOHNES, London. Assigned to Applied High Frequency Ltd., London, England. Filed Jan. 5, 1948. Granted Oct. 2, 1951.

Patent refers to a spot electrode for use in welding dielectric plastics by the use of high frequency heating. It comprises a cylindrical electrically-insulating shell, a refractory insulating pressure member concentric with the shell and axially-movable therewithin in relation thereto against the resilient restraint imposed by a helical spring positioned between the pressure member and an abutment on the shell.

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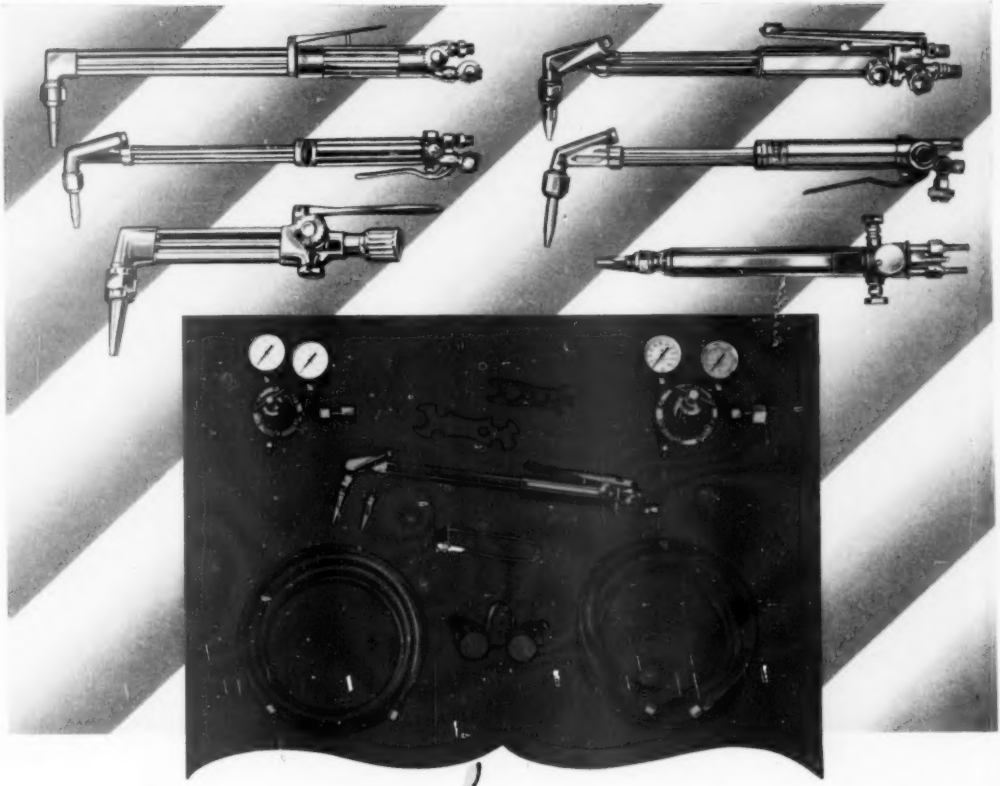

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